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COST-BENEFIT ANALYSIS OF IMPLEMENTING A CAR-SHARING MODEL TO THE NAVY'S PASSENGER VEHICLE FLEET

December 2016

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The purpose of this study is to examine the costs and benefits of utilizing a commercial car-sharing model or implementing a Fleet-Sharing solution to replace the current ownership model administered by Naval Facilities Engineering Command (NAVFAC). We will use a Cost-Benefit Analysis (CBA) framework to analyze a data set provided by NAVFAC for the Naval Air Station (NAS) Jacksonville (JAX) locality and compare the net benefit of three available alternatives. The first alternative is continued operation with the current model (Status Quo). The second alternative is replacement of the current model with a contractor operated commercial car-sharing model. The third alternative involves integrating a fleet management hardware/software solution (fleet-sharing).

The goal of this CBA is to compare alternatives in order to identify the one with the highest net benefit. The data set conclusively supports alternative three, which provides a reduced initial cost versus the status quo and a cumulative net present value. Therefore, we recommend implementing a fleet-sharing solution to the existing fleet at NAS JAX.

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LIST OF ACRONYMS AND ABBREVIATIONS

AO	Authorizing Official
BSVE	Base Support, Vehicles, & Equipment
CAC	Common Access Card
CBA	Cost-Benefit Analysis
CNO	Chief of Naval Operations
CO	Commanding Officer
CONUS	Contiguous United States
CY	Current Year
DOD	Department of Defense
DOT	Department of Transportation
EC	Equipment Code
ENGCOM	Engineering Command
EXWC	Engineering and Expeditionary Warfare Center
FEC	Facility Engineering Commands
FHWA	Federal Highway Administration
FMIS	Fleet Management Information System
FY	Fiscal Year
GS	General Schedule
GSA	General Services Administration
HAZMAT	Hazardous Material
IA	Information Assurance
IO	Inventory Objective
IT	Information Technology
JAX	Jacksonville, FL
MIDLANT	Mid-Atlantic
MIDWEST	Mid-Western
MPG	Miles per Gallon
MSRP	Manufacturers Suggested Retail Price
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command

NAVSTA	Naval Station
NPU	Number at Peak Usage
NPV	Net Present Value
OMB	Office of Management and Budget
POV	Privately Owned Vehicles
PVB	Present Value Benefits
PVC	Present Value Costs
RFID	Radio-frequency Identification
RMF	Risk Management Framework
ROB	Regional Office Building
T&T	Travel and Transportation
USN	United States Navy
WCF	Working Capital Fund
WTP	Willingness to Pay
VAM	Vehicle Allocation Methodology
XO	Executive Officer

I. INTRODUCTION

A. BACKGROUND

The U.S. Navy currently maintains a fleet of approximately 3,300 motor vehicle assets to support its operations and mission requirements across the globe. Many of these vehicles are leased by individual Navy commands on a long-term basis and are then utilized for a few hours each day, or sometimes less, spending the remaining time idle in the parking lot. In an era of shrinking budgets and increased financial accountability, requirements such a large and potentially underutilized fleet represents a significant cost driver for the Navy. Naval Facilities Engineering Command (NAVFAC), the government entity charged with the responsibility for managing the Navy's motor vehicle fleet, believes there is a potential for significant cost avoidance and efficiency gains through a reduction in motor vehicle fleet size and its associated costs. Two alternatives identified to achieve this reduction identified by NAVFAC are the adoption of a commercial car-sharing model, exemplified by Zip-Car and Enterprise Car Share, or the adoption of a fleet-share model, which integrates commercial fleet-sharing technology into the pre-existing motor vehicle fleet. Collectively, these two options are referred to as vehicle sharing for the duration of this cost-benefit analysis. NAVFAC estimates the potential introduction of a vehicle-sharing alternative to the existing model on a naval installation to be feasible and the return relatively high.

B. PURPOSE

The purpose of this analysis is to develop a robust methodology encompassing key parameters, such as vehicle mileage and utilization rates, to determine the optimum number and mix of vehicles required to operate a vehicle-sharing operation for long-term lease vehicle assets (B-Pool) at Naval Air Station (NAS) Jacksonville, Florida. Then, using the previously determined optimum number of vehicles, conduct a cost-benefit analysis for the implementation of a vehicle-sharing model at NAS Jacksonville to answer the following questions:

- Could implementation or integration of a commercial car-sharing model or commercially procured fleet-sharing hardware/software be financially beneficial to the Navy? If so, how?
- Can vehicle utilization be increased, while reducing fleet size using available alternatives? If so, by how much?
- What are additional pros and cons of the available alternatives, and what are the specific challenges from the Navy perspective?

C. LIMITATIONS OF RESEARCH

Ideally, data would be collected using installed hardware and software packages, known as telematics, on each General Services Administration (GSA)-owned vehicle. Unfortunately, during the installation phase, which ran from October 2015 to January 2016, there were complications stemming from the addition of new regulatory requirements introduced in the Department of Defense Instruction (DoDI) 8510.01 (Department of Defense [DOD], 2014). This Risk Management Framework for Department of Defense (DOD) Information Technology (IT) required that all Navy systems that record and transmit Navy data incorporate numerous security controls and be certified as compliant with Navy cybersecurity requirements (Takai, 2014). The administrative and fiscal burden associated with DoDI 8510.01 prevented the successful completion of the implementation of telematics devices in the Navy motor vehicle fleet and the project remains ongoing. NAS Jacksonville, the location chosen by NAVFAC for this analysis, does not yet have the telematics technology installed on their vehicle fleet so the analysis was conducted using available data retrieved from NAVFAC's MAXIMO system. MAXIMO is the enterprise resource used by NAVFAC to manage all data associated with the motor vehicle program.

This analysis conclusively supports the adoption of a fleet-sharing model at NAS Jacksonville. Based on the findings of this cost-benefit analysis, the integration of fleet-sharing telematics technology greatly reduces fleet size and operating costs while potentially increasing customer satisfaction and user convenience. This model also has significant potential for expansion to additional Navy locations with similar reductions in fleet size and operating costs.

II. PILOT STUDY REVIEW

Currently, the Navy maintains an enormous fleet of vehicles to sustain the daily operations of the fleet and all of its supporting commands. Naval Facilities Engineering Command (NAVFAC) is the entity designated by the Navy with responsibility for managing all aspects of the Navy's motor vehicle fleet. Under the current motor vehicle management and procurement model, NAVFAC leases or buys vehicles from the General Services Administration (GSA) and then leases them to other Navy commands, from here on referred to as customers, using a two tiered leasing model based on term length. Assets used to fill short-term rental needs for non-standard or non-recurring requirements and are rented on an hourly or daily basis are C-Pool assets. B-Pool assets are used to fill customer's full time vehicle requirements and are leased on a long-term basis with a flat monthly lease rate. This monthly fee, known as the Base Support, Vehicle and Equipment (BSVE) rate, also covers all fuel, maintenance and repair costs associated with the vehicle. Once leased on a long-term basis the vehicle is completely at the leasing commands disposal to be used as needed to meet mission requirements. When not in use, the vehicle sits idle until needed. Data provided by NAVFAC suggests that the current motor vehicle fleet is underutilized and GSA, NAVFAC and other government departments continue to research innovative alternatives to the current motor vehicle model that offer potential cost savings to the Navy and its customers. The purpose of this paper is to analyze vehicle sharing as a potential alternative to the current motor vehicle model. The two vehicle-sharing alternatives that will be studied and compared to the current model are car-sharing and fleet-sharing.

Commercial car-sharing companies, such as Zipcar and Enterprise Car Share, are becoming more common in densely populated areas and share similar functionality. The vehicles are parked in designated areas and reserved using mobile or Internet connected applications. An approved reservation allows the leasee to pick up the specific vehicle at a designated time and place and use it as required until the reservation period ends. Fuel is included in the hourly price and borrowers pay only for the duration of their reservation.

Fleet-sharing companies provide telematics and vehicle access hardware such as Radio-Frequency Identification (RFID) cards to organizations to allow them to self-manage their fleets in a manner similar to commercial car-sharing companies. Telematics is a system of hardware and software options integrated into the motor vehicle that collects, stores, and transmits utilization data such as time and mileage to a management server. The fleet-sharing technology provider allows customers' access to the server to track utilization and manage fleet maintenance and other requirements. They also provide customers with access to a technology-]based server that allows the customer's employees to reserve shared vehicles via mobile or Internet connected applications.

The primary difference between commercial car-sharing and fleet-sharing is the ownership of the vehicles. With a car-sharing alternative, all shared vehicles are owned and managed by the commercial car-sharing company. With fleet-sharing, all shared vehicles are owned and managed by the government using commercially provided vehicle telematics technology. Both options offer the potential to significantly reduce total fleet size since the total pool of vehicles is now shared among all of the commands and rented on an hourly basis as needed, rather than leased by individual commands on a monthly basis and left idle for long periods when not in use.

This chapter will present an analysis of the most recent pilot studies conducted by government entities and determine whether the data is accepted as relevant to the current pilot study to be conducted at Naval Air Station (NAS) Jacksonville in Florida, as shown in Table 1. The pilots are grouped into separate car-sharing and fleet-sharing categories.

Since 2009, NAVFAC and GSA have conducted four pilot studies in selected regions around the country with a wide range of results. A review of the car-sharing and fleet-sharing pilots conducted by the government will provide insight on how these models could be implemented on a full scale operational basis instead of an isolated segment within a base operation.

Table 1 lists the pilots considered and accepted for review based on the following pilot acceptance criteria.

- Direct replacement (not merely offered as an additional option) of GSA fleet by Commercial Car-Sharing Fleet or implementation of

Fleet-Sharing Hardware/Software to the existing GSA fleet issuance model.

- Pilot time ≥ 30 days
- ≥ 10 drivers supported by assigned vehicles
- ≥ 10 vehicles altered (Fleet-Sharing programs only)
- Vehicles used to support varied tasks (not all used on a recurring route)

Table 1. Pilot Accepted Minimum Metrics.

Pilot No.	Pilot Year (date)	Fleet Share	Car-Share	≥ 30 days	≥ 10 drivers	≥ 10 vehicles	Varied vehicle use
1A	NAVFAC 2009 (Norfolk, VA)	X		6 mo	Yes (400)	Yes (33)	X
1B	NAVFAC 2011 (Bangor, WA)	X		5 mo	Yes (300)	Yes (13)	X
1C	NAVFAC 2011 (Great Lakes, IL)	X		5 mo	Yes (150)	Yes (20)	X
2	GSA 2011 (San Diego, CA)	X		6 mo	Yes (203)	Yes (20)	X
3	GSA 2014 (Chicago, IL)	X		2 mo	Yes (40)	No (3)	X
4A	GSA 2015 (Wash DC)		X	6 mo	Yes (17)	NA	X
4B	GSA 2015 (Providence, RI)		X	4 mo	No (2)	NA	X

A. 2009-2011 NAVFAC FLEET SHARE PILOT

1. Pilot Summary

Cook, Ahn, & Rotty (2013) analyzed a three-year pilot program testing a fleet-sharing model. The pilot was a coordinated effort by NAVFAC Engineering and

Expeditionary Warfare Center (EXWC) to test and demonstrate a vehicle fleet management suite as an alternative to manual reservation and assignment. INVERS Mobility Solutions Inc. was contracted by EXWC to install a varied level of hardware and software in GSA or Navy owned passenger vehicles. The locations selected for testing were three NAVFAC Mid-Atlantic (MIDLANT) Engineering Command (ENGCOM) Facility Engineering Commands (FEC), each in different places in the contiguous United States (CONUS). Respective regions received a vehicle access/ ignition key management and vehicle reservation system, but the level of vehicle installation varied. The following metrics were evaluated by Cook et al. based on pilot performance.

- Connectivity: Remote connectivity between the key management units, the vehicle computers, and the web server.
- Durability: Measure of hardware resistance to failure throughout the pilot demonstration.
- Installation: Ability to install equipment throughout the three regions.
- Key management: Ability to track and manage keys using IT solutions.
- Reliability: Measure of system connectivity throughout the pilot demonstration.
- Reporting: Database reporting capability (billing/reports/ utilization)
- Value added: Overall results of Information Technology (IT) solution for fleet management and whether it allowed a fleet reduction or a utilization increase.
- Web-access: System remote accessibility

2. Pilot 1A. Norfolk, VA, Details

NAVFAC MIDLANT on Naval Station (NAVSTA) Norfolk maintains a combination of 33 GSA- and Navy-owned vehicles. The Navy vehicles received the onboard computer systems but the GSA vehicles only received a non-operative placebo unit. Prior to the pilot, the facility reported excessive idle time, and billing and timing

conflicts. At the conclusion of the six month pilot, Cook et al. (2013) reported the efficiencies gained in vehicle utilization were so high, they reduced the fleet size by 27% (9 vehicles) and further reduced fuel and rental costs by replacing their fleet minivans with sedans. The command ultimately opted to retain the system at the completion of the pilot and established a contract to expand to other locations within the region.

3. Pilot 1B. Bangor, WA Details

NAVFAC NORTHWEST on Naval Base Kitsap (NBK) maintains a small fleet of 13 GSA vehicles. Although the shore base management-system hardware was used, none of the vehicles received the onboard computer systems. Prior to the pilot, the facility reported an insufficient number of vehicles to meet the user's needs, a lack of a formal reservation process, and a lack of accountability. At the conclusion of the five month pilot, the data analysis supported an increase in the fleet size from 13 to 15 and the command opted to retain the utilized system components at the completion of the pilot due to the user efficiencies gained (Cook et al., 2013).

4. Pilot 1C. Great Lakes, IL Details

NAVFAC Mid-Western (MIDWEST) on NAVSTA Great Lakes maintains a fleet of 20 Navy owned vehicles between two buildings, all of which received the onboard computer systems. Prior to the pilot, the facility reported sufficient vehicles and a self-checkout document with openly accessible keys. At the conclusion of the five month pilot, the efficiencies gained in vehicle utilization supported a fleet reduction of 30%. Additionally, the command opted to retain the system at the completion of the pilot and expand the system usage within the region (Cook et al., 2013).

5. Costs and Assumptions

Table 2 summarizes the potential costs saving that were obtained by reducing the fleet size based on the utilization observed during the pilot study. Bangor is not listed due to the absence of vehicle installed hardware. The table savings are based on the following assumptions.

- Monthly vehicle cost (2013) of $210 based on composite passenger prices.
- Monthly service charges: Navy Web Server $170, vehicle installation $20 each, key cabinets $80 each.
- No change in administrative labor for vehicle management

Table 2. Estimated Cost Savings of Fleet Reduction. Adapted from Cook et al. (2013)

Fleet Management	Baseline Fleet	Adjusted Fleet	Cost Differential (Baseline-Adjusted)[1]	Monthly Car-Sharing Fees[2]	Monthly Savings
NAVSTA Norfolk	33	24	$2,160	$810	$1,350
NAVSTA Great Lakes	20	13	$1,680	$629	$1,051
NAVSTA Bangor, WA	13	15	($480)	$550	(1,030)
Total	53	37	$3,360	$1,989	$1,371

6. Challenges

A comparative analysis between each pilot presents some challenges when common requirements are not used. The following list details some of the issues that complicate the comparison:

- The pilot used the commercial servers to manage the data for users and vehicle reservations, contrary to the new Navy Information Assurance (IA) policy, which now requires Navy data to be hosted on contracted Navy servers.
- A process for preventing users from holding keys past the vehicle usage was not used.

- The study did not include a solution for providing vehicle fuel. Presently, commands are issued their own fuel cards to be used for the command assigned vehicle.

B. 2011 GSA FLEET SHARE PILOT

1. Pilot Summary

In this pilot report, Serafino (2011) analyzed a GSA-coordinated pilot contract that was awarded to Zipcar based on a request for proposals. The pilot was located at the Naval Facilities Engineering Command Southwest (NAVFAC SW) in San Diego, CA. It was active for six months with an additional month for setup and training. NAVFAC SW maintained a fleet of 20 Navy owned vehicles. Each vehicle received a telematics unit for GPS tracking and management server connectivity, and an RFID card reader that allowed vehicle access. Each driver was assigned a personal RFID card and training for program use.

The primary goals were to:

- Determine the feasibility of Fleet-Sharing with telematics and Radio-frequency Identification (RFID) cards for vehicle access.
- Determine capability of users to use a web-based self-service reservation system.

A secondary goal upon data collection was to identify a course of action to achieve a utilization of 60–65% during a 10 hour business day.

2. Assumptions and Costs

Although no specific assumptions or contract costs were published in Serafino's report, some approximate data can be extrapolated from the percentage improvements provided.

- Business hours are defined as Monday-Friday, 0730 to 1730 for purposes of utilization calculations.
- Reservation averages in shared fleets outside the pilot are between 5 and 20 miles per trip.

3. Challenges

Many of the vehicles used in this pilot are driven over 300 miles during a single reservation based on mission requirements. This extended range creates a difficult comparison to the users in Jacksonville, which are estimated to be far lower but without installed telematics, cannot be verified.

4. Results

Although the San Diego Pilot was a small sample and included most personnel with a similar mission, it was met with a high degree of user popularity and provided usable data for our comparison CBA. Specifically targeting our primary analysis question, Serafino concluded that reducing unused time by 40% (2,000 hours) and removing 1–4 vehicles from the fleet could help achieve the secondary goal (achieve 60–65% utilization) while reducing fleet size. Serafino (2011) reported additional data analysis indicating:

- Both primary goals were met with success. The telematics and RFID readers performed as designed and the users were adept at using the web-based reservation system.
- The fleet-sharing pilot averaged 52% utilization during regular business hours. Due to the nature of the mission (longer range, longer trip duration), identifying a target usage may be less than in the Jacksonville area.
- *Unused reservation time*, or time at the beginning and end of the reservation where the vehicle is reserved but idle, accounted for over 25% (over 5,000 hours) of all reservations.
- Reservation *No-Shows* accounted for over 750 hours (over 100 No-Shows in total) of reservation time, however improved policy and training can reduce the No-Show time.

A post-pilot survey was provided to the users regarding the fleet-sharing program. On average, over 85% of the users that responded felt the fleet-sharing model was easier, faster, and more flexible (obtaining the right vehicle for the mission) than the NAVFAC fleet model in use prior to the pilot (Serafino, 2011).

C. 2014 GSA FLEET SHARE PILOT

In 2015, General Services Administration, released a report analyzing a pilot program at the Federal Garage in downtown Chicago, IL. The pilot contract was awarded to Local Motion (now a subsidiary of ZipCar) in 2014 based on a small-business set aside invitation for bids to provide a full functionality mobile application based platform. The GSA vehicles were scheduled to receive onboard autonomous computer systems while the rest of the facility located system would be managed by Local Motion Inc. Although the initial contract was for a 10-vehicle fleet, technical difficulties with vehicle installation prevented full installation. Additionally, a maximum of three cars were used during the pilot because the contractor defaulted on the contract only two months after vehicle usage commenced (and just two weeks before a planned hardware installation on 10 more cars). Therefore, the low number of cars used and the short duration rendered this pilot insufficient for a full comparison.

D. 2015 GSA CAR-SHARING PILOT (AIKEN, 2016)

1. Pilot Summary

In the report by Aiken (2016), he investigates a coordinated effort by the GSA Office of Travel and Transportation (T&T) to test and demonstrate multiple commercial car-sharing/hourly rental models as an alternative to manual reservation and assignment. The GSA T&T awarded a Blanket Purchase Agreement (BPA) to four commercial car-sharing companies in four CONUS cities. Of those, only the GSA Regional Office Building (ROB) in Washington, DC, was identified as a potential candidate for the study. Additionally, the Department of Transportation (DOT) Federal Highway Administration (FHWA), Rhode Island Division, which was not one of the selected BPA options, engaged GSA about testing a car-sharing model and was accepted.

It is important to acknowledge the major difference between this case study and the previous pilot studies. This pilot studied a direct replacement of a GSA owned fleet using commercial car-sharing companies in a pre-established car-sharing market instead of implementing fleet management hardware/software into a pre-existing fleet.

The remote vehicle reservation and on-site vehicle use operations for both locations are similar. Reservations are made online via computer or mobile application and access is given to the vehicle if the associated membership card is present at the time of reservations. The keys and a fuel card are located inside the vehicle. The companies have standard hourly usage fees and additional fees for returning the vehicle late, with low fuel, dirty, etc.)

2. Pilot 4B. Providence, RI, Details

The DOT FHWA RI only has one fleet vehicle assigned and 11 registered drivers. A contract was awarded to Zipcar to support the registered users for the duration of the pilot study. Unfortunately, the DOT office announced that use of the Zipcar vehicles was not mandatory and therefore, only four users registered with Zipcar, one of which never activated the member card and another never made a reservation. Therefore, the low number of actual users renders this pilot insufficient for a full comparison.

3. Pilot 4A. Washington, DC, Details

The ROB in DC designated 17 users to register and use the car-sharing platform instead of the fleet vehicles (which were not impacted by the study). The Office of Administrative Services subsequently revoked those users' motor pool access in support of the pilot study. Enterprise was selected as the vendor and awarded a six-month contract to provide support services to the selected users. The vehicles did not have telematics to report actual usage so the data provided is based on the web based reservation system.

4. Costs, Assumptions, and Usable Metrics

The DC area is difficult to relate to NAS Jacksonville (JAX) due to the excessive traffic density, however the averages reported by Aiken (2016) may still be applied to our model in lieu of available telematics data.

- Average trip: 39 miles
- Average reservations: 6.5 hours
- Average use cost: 36.50 (not including fees)

Table 3 lists the per hour charges and rental time requirements as well as vehicle availability.

Table 3. Hourly Car-Sharing Costs versus GSA Fleet Lease.
Adapted from Aiken (2016)

	Hourly Car-sharing	GSA Fleet Lease
Average Hourly Rate (economy sedan)	$8.14 (includes fuel)	N/A
Average Daily Rate (economy sedan)	$55 (Unlimited mileage)	$5.56 *(based on $169/mo and $0.15/mi)
Vehicle Types	Sedans, SUVs	All GSA vehicles
Reservation min lead time	1 Hour	Days to weeks (varies based on availability)
Rental extension availability	>15 min of scheduled reservation end time (pending availability)	Open ended reservation (no time limit)

* Based on compact sedan rates

5. Results

Table 4 breaks down the charges that the ROB incurred with Enterprise versus what the cost would have been had the GSA fleet been used. It is important to note that though the average trip distance is 39 miles, which would be significantly lower in Jacksonville, the number of trips taken in Jacksonville would also be higher based on a higher demand and therefore a higher utilization.

Table 4. Enterprise Car Share versus GSA Fleet Lease.
Source: Aiken (2016)

	Enterprise Car-Share	GSA Fleet Lease
Rental/Lease Rate	$7.00/hr	$169/mo
Mileage Charges (2,351 miles)	N/A	$0.153/mile
Total Costs (minus fees)	$2,193.25	$1,373.70
Average Monthly Cost (minus fees)	$365.54	$228.95
Total Costs (including fees)	$2,642.25	$1,373.70
Average Monthly Cost (including fees)	$440.38	$228.95

The fees listed on the total costs row in Table 4 for Enterprise are a result of user agreement violations. These fees are relatively standard for car-sharing companies and include the following (Aiken, 2016):

- Late returns
- Low fuel returns (less than1/4 tank)
- Returning vehicle dirty
- Returning vehicle to the wrong location
- Losing vehicle key or failing to place key in the car upon return
- Losing membership card
- Unauthorized driver operating vehicle
- Unreported vehicle damage/theft

Additionally, though not considered a violation fee, reservation no-shows accounted for almost 100 hours (23%) of reservation time. Commercial car-sharing vendors charge for time reserved not time used.

Some of the Aiken's findings were non-quantitative and difficult to apply to a Cost-Benefit Analysis (CBA) (Aiken, 2016). Some of them are listed here.

- Reservations can be made up to 15 minutes prior to requirement.
- Reservations can be extended ad-hoc if the vehicle does not already have a pending reservation.

III. METHODOLOGY

A. COST-BENEFIT ANALYSIS (CBA)

A CBA identifies, quantifies, and monetizes the variables that affect the selected stakeholders in every facet of a selected project to facilitate rational decision making by providing a data driven recommendation. The selected CBA method will be an *Ex Ante* CBA (prior to execution) to provide a recommendation for decision making before an alternative is selected. The CBA nine-step method in Table 5 provides the framework for constructing the analysis and making a recommendation.

Table 5. Major Steps in a CBA.

1) Specify the Set of Alternatives
2) Determine Standing
3) Catalog of Impacts and Measurement Indicator Selection
4) Quantitative Impact Prediction Over Project Life
5) Impact Monetization
6) Calculate Present Value
7) Calculate Net Present Value
8) Perform a Sensitivity Analysis
9) Make a Recommendation

Source: Boardman, Greenberg, Vining, & Weimer (2011)

B. OPTIMUM FLEET SIZE

The primary impetus behind the investigation of vehicle-sharing options at Naval Air Station (NAS) Jacksonville is the intuitive understanding that the majority of long-term lease (B-Pool) fleet assets are significantly underutilized by commands and the knowledge that costs savings can be achieved by right sizing the vehicle fleet to improve per unit vehicle utilization. The reduction in B-Pool vehicle inventory represents the single most important monetized benefit of adopting a vehicle-sharing program, and as such, the calculations adopted to determine the recommended fleet size will have an enormous impact on the outcome of this cost-benefit analysis.

The first step in optimizing the fleet size is determining the total number of vehicles in Jacksonville that would be eligible for vehicle sharing. Some vehicles, because of mission requirements and others because of location or vehicle type are not good candidates for a vehicle-sharing program. The raw data provided by Naval Facilities (NAVFAC) from their *MAXIMO* database management system includes 411 individual vehicles managed by the NAVFAC operation at NAS Jacksonville (S. Kurup, personal communication, 13 September 2016), of which only 121 of those vehicles were determined to be eligible for the car-sharing project, per Table 6.

Table 6. Determination of Vehicle Eligibility for Vehicle Sharing

Total Fleet Size	411
Less: Vehicles Pending Sale	27
Less: Low Speed Vehicles	65
Less: Buses	9
Less: Commercial Vans	24
Less: Pickup Trucks, 4x4	19
Less: Commercial Trucks	40
Less: Public Safety	29
Less: Public Works	43
Less: Navy Band	6
Less: Offbase Vehicles	27
Less: Duplicate Tag #	1
Vehicle Population Eligible for Car Share	**121**

Of the 411 total vehicles, 29% of them were removed from the sharing population for the following reasons:

- 27 vehicles were removed from consideration because they are listed as pending sale, which means that NAVFAC has already identified these assets as excess.
- 65 low speed vehicles were removed from the data under consideration because this type of vehicle is not eligible for car-sharing.

- Nine buses, 24 commercial vans, 40 commercial trucks and 19 four-wheel drive pickup trucks were similarly removed because these are specialized vehicle types, which do not fit into the vehicle-sharing model. The commercial vans include panel vans utilized by maintenance personnel and five-ton cargo vans utilized by base personnel to move bulk cargo and equipment. The commercial trucks include large stake trucks used to move cargo and equipment around base as well as fuel trucks and tractor trailers essential to airfield operations.

- 29 public safety vehicles utilized by the base police force, security department and fire department, as well as the Commanding Officer (CO) and Executive Officer (XO) command vehicles, were also excluded because these vehicles are mission essential for these operations.

- Six passenger vans utilized by the Navy Southeast Region Band were also excluded because band members travel all over the region to play at concerts, changes of command, and other official Navy events. The longer distances and times associated with these trips make the vehicles poor candidates for vehicle sharing.

- 43 public works vehicles were excluded because these are work vehicles that are used by individuals and commands on a daily basis to carry out maintenance, hazardous material (HAZMAT) and inspection operations on base.

- 27 additional vehicles were removed because they were listed as being located at various locations off base and in some cases outside of the Jacksonville geographic area, such as Puerto Rico, Altoona and Cecil Field. Although these vehicles are managed by the NAVFAC operation at NAS JAX, they fall outside of the geographic radius of the car-sharing project and were therefore deemed ineligible. A small subset of the 27 vehicles had no location given so it was impossible to determine if they were located off base or on base. Because of the uncertainty, these vehicles were removed from consideration.

- Finally, one vehicle was listed twice in the MAXIMO extract and the duplicate entry was removed from the list of eligible vehicles.

The population of vehicles at NAS Jacksonville determined to be eligible for a vehicle-sharing program was 121. Table 7 displays the breakdown of the eligible vehicles including numbers, types, and applicable Navy Equipment Codes (EC).

Table 7. Vehicles Eligible for Car-Sharing at NAS Jacksonville.

Vehicle Category	Navy EC	Qty
Truck, Pickup Compact 4x2	0319	17
Truck, Pickup 4x2, Crew Cab	0327	32
Truck, 1/2T Pickup 4x2	0313	7
Truck, Sport Utility, Commercial, 4x2 Midsize	0308	2
Truck, Van, 7 Pass, Compact	0330-08	24
Truck, Van, 8 Pass	0330-01	5
Truck, Van, 12 Pass	0330-03	12
Truck, Van, 15 Pass	0330-05	12
Sedan, Sub Compact	0103	2
Sedan, Compact	0104	8
Total:		**121**

The second step in the process is determining whether the vehicle fleet in Jacksonville is actually underutilized by calculating the current utilization of the B-Pool assets at NAS Jacksonville. The actual utilization levels must be estimated because telematics has not yet been installed on NAVFAC's fleet in Jacksonville to record this data. The utilization of a vehicle includes the time it is physically used to drive from the point of origin to a destination, the idle time at that destination where the vehicle is not available to another driver, and the time that it is used to return to the point of origin. NAVFAC tracks the average annual miles that a vehicle is driven, but they do not record the number of hours that each vehicle is in use, so an estimate will be made to convert miles driven into hours utilized. Table 8 presents data from the fleet-sharing pilot conducted by GSA at Naval Station (NAVSTA) San Diego, CA and the car-sharing pilot conducted by GSA at their facilities in Washington, DC.

Table 8. Miles Driven to Utilization Conversion.

Pilot	San Diego, CA	Washington, DC
Hours	20,500	397
Miles	190,000	2,351
Hours/Mile	0.11	0.17
Avg. Hours/Mile	**0.14**	

Adapted from Aiken (2016) and Serafino (2011)

The average number of hours per mile driven in the San Diego pilot study was .11 Hours/Mile and the average number of hours per mile driven in the Washington pilot study was .17 Hours/Mile. The average of these two calculations is .14 Hours/Mile. Although vehicle utilization at NAS Jacksonville is expected to more closely reflect the conditions during the pilot study in San Diego, CA than the pilot study in Washington, DC, due to the limited amount of existing data, the average of the two calculations was selected as a conservative estimate. This average (0.14 hours/mile) will be used as the factor in this CBA to convert miles driven into utilization. There are on average 21 workdays in a given month, and eight working hours in a given workday. This equates to 2016 working hours in a fiscal year, which is the factor that will be used to convert utilization hours to a utilization percentage or rate. For the remainder of this CBA, 2016 working hours will be used as the average number of working hours in a fiscal year. Table 9 displays the calculated utilization rate by platform for the NAS Jacksonville fleet. The overall utilization rate over the eight-hour workday is quite low at 22.10%. This equates to an average daily utilization rate of 7.37% based on a 24-hour day, which is the car-sharing industry standard.

Table 9. Current Utilization of Eligible Vehicles at NAS Jacksonville.

Vehicle Category	Utilization Rate
Truck, Pickup Compact 4x2	16.98%
Truck, Pickup 4x2, Crew Cab	14.85%
Truck, 1/2T Pickup 4x2	12.96%
Truck, Sport Utility, Commercial, 4x2	18.88%
Truck, Van, 7 Pass, Compact	20.71%
Truck, Van, 8 Pass	44.30%
Truck, Van, 12 Pass	23.88%
Truck, Van, 15 Pass	26.91%
Sedan, Sub Compact	19.46%
Sedan, Compact	22.03%
Average Utilization Rate:	**22.10%**

The next step is determining the desired utilization level for the motor vehicle fleet at NAS Jacksonville. According to a 2016 study on the future of car-sharing, the Boston Consulting Group estimates that by 2021, the typical car-sharing vehicle "will run at a utilization rate of 15%, which allows time for fueling maintenance, and repositioning" (Bert, Collie, Gerrits, & Xu, 2016). They also argue that while 15% may seem low it is in the best interest of car-sharing service providers to "maintain what may sound like a lower-than-expected usage rate in order to ensure that vehicles are available during peak periods" (Bert et al., 2016, p.10). In the case of NAS Jacksonville, lack of vehicle availability when needed would negatively affect both customer satisfaction and mission accomplishment.

A 15% utilization rate over a 24-hour period equates to a 45% utilization rate over an eight hour period. Therefore, a 45% utilization rate over the course of an eight hour working day, which is considered the peak period at NAS Jacksonville, is the target selected for this CBA. An increase in utilization from 22.1% to 45% effectively doubles the vehicle utilization rate at NAS Jacksonville, which is an achievable goal that balances NAVFAC's desire to both significantly increase vehicle utilization and shrink the government vehicle fleet while maintaining high levels of customer satisfaction. It is also in line with the 52% utilization observed over a 10-hour workday during the GSA

vehicle-sharing pilot conducted at NAVSTA San Diego in 2010 and 2011, which was the only pilot to report utilization results (Serafino, 2011).

The eight-hour workday is also a conservative estimate. In reality the working day at most naval facilities is well in excess of eight hours, especially for military and other duty personnel. The actual utilization over a 24-hour day will certainly exceed 15% if 45% utilization is maintained over the assessed eight hour peak period.

A 45% utilization rate over an eight hour day equates to a target utilization of 3.6 hours per vehicle per work day or 907.2 hours per vehicle per year. Using the average annual mileage for NAS Jacksonville and the previously derived factor of 0.14 hours/mile, the required number of vehicles at NAS Jacksonville, per Table 10, is 54. This is significantly less than the current fleet size of 121 vehicles.

Table 10. Recommended Number of Vehicles at NAS Jacksonville.

Vehicle Category	Average Miles (Annual)	Average Hours/Mile	Average Total Hours (Annual)	Desired Utilization (%)	Desired Utilization (Hours/Day)	Desired Utilization (Hours/Year)	Required Vehicles
Truck, Pickup Compact 4x2	41,574	0.14	5,820	45%	3.6	907.2	6
Truck, Pickup 4x2, Crew Cab	68,448	0.14	9,583	45%	3.6	907.2	11
Truck, 1/2T Pickup 4x2	13,069	0.14	1,830	45%	3.6	907.2	2
Truck, Sport Utility, Commercial, 4x2	5,437	0.14	761	45%	3.6	907.2	1
Truck, Van, 7 Pass, Compact	71,587	0.14	10,022	45%	3.6	907.2	11
Truck, Van, 8 Pass	31,897	0.14	4,466	45%	3.6	907.2	5
Truck, Van, 12 Pass	41,267	0.14	5,777	45%	3.6	907.2	6
Truck, Van, 15 Pass	46,497	0.14	6,510	45%	3.6	907.2	7
Sedan, Sub Compact	5,605	0.14	785	45%	3.6	907.2	1
Sedan, Compact	25,377	0.14	3,553	45%	3.6	907.2	4
Total:	**350,758**		**49,106**				**54**

C. SUMMARY

By implementing a vehicle-sharing operation at NAS Jacksonville, target per vehicle utilization can be increased from 22.1% to the target utilization rate of 45%, with a 16.3% (67 out of the 411 currently in use) overall reduction in fleet size. A completed analysis of the vehicle cost and use data provided by NAVFAC, GSA, and other public domains will result in an apples-to-apples comparison of Net Present Value (NPV) between the two alternatives and the status quo, which has an NPV of zero.

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IV. COST-BENEFIT ANALYSIS

A. SPECIFY SET OF ALTERNATIVES

This study is under the guidance of Naval Facilities Engineering Command (NAVFAC), and therefore will focus on the alternative options that are most relevant to current technology and commercial availability. The Cost-Benefit Analysis (CBA) will use the steps listed in Chapter III to compare the net social benefits of the specified alternatives to the net social benefits of the status quo (in this case the existing General Services Administration (GSA) Fleet Management).

1. Status Quo

GSA purchases a wide range of vehicles from commercial trucks and vans to battery-powered vehicles. GSA then leases the vehicles to various government entities, such as the Department of Defense (DOD). Within the Navy, NAVFAC is the primary management entity responsible for issuing, maintaining, and returning the leased vehicles as required. NAVFAC has two primary levels of vehicle issue management.

- "B-Pool" Long-Term Rentals (continuous assignments)
- "C-Pool" Short-Term Rentals (daily assignments leased as needed). Any portion of a day leased counts as a full day. Vehicles are limited to 100 miles or seven gallons of fuel per day.

Per NAVFAC guidelines, B-Pool vehicle assets are the sole focus of this cost-benefit analysis. The NAVFAC Base Support Vehicles & Equipment (BSVE) Department assigns vehicles after a command has established an initial Inventory Objective (IO). Additionally, each command will conduct an annual Vehicle Allocation Methodology (VAM) as required by a presidential memorandum by reporting vehicle information in the Fleet Management Information System (FMIS) to ensure only required vehicles are being maintained and leased. Operational differences arise between shore commands and operational commands only in the frequency with which the vehicles are assigned.

Due to the process flow for B-Pool assets existing in a steady state, it is possible to accurately predict total vehicle fleet number requirements through the identification of flow rates and inventory stores within the process flow. Actual customer demand for the status quo is assessed though the current vehicle inventories assigned to supported tenants. Customer demand for the proposed commercial car-sharing and fleet-sharing alternatives are assessed through the cost-benefit analysis and the assumptions contained therein. For possible inventory stores not related to vehicles under customer assignment, such as the various categories of maintenance, process capacity is such that inflows cause no backlog. It is assumed that any future alternative will scale current processes to maintain this lack of inventory scores. This is the case throughout all of the alternatives with the exception of the unassigned vehicle lot for the status quo, which is not present in the other options.

a. Operational Command Lease Process

Although operational commands experience periods in which no vehicles are required due to deployment or training, the IO is not required every time. Due to the nature of Naval Air Station (NAS) Jacksonville tenant commands and their assigned missions, this report will focus primarily on the shore command process. Further analysis in support of operational commands is listed in Chapter V for future research.

b. Shore Command Lease Process

Shore commands retain a relatively static workforce and mission and subsequently a static vehicle demand throughout the year. Figure 1 provides a detailed process model for how vehicles are issued, maintained, and returned with the current shore command leasing process. Inventory flows are given in cars per week and the values are provided as examples only.

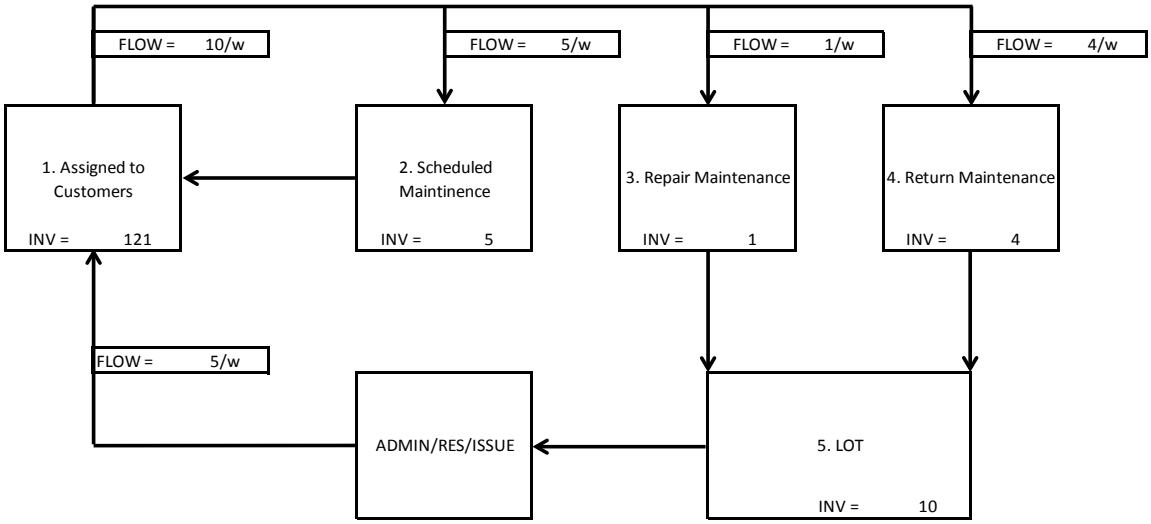

Figure 1. Status Quo Process Flow for B-Pool

The current state of the Naval Air Station vehicle fleet is based on a legacy system centered on long-term assignments to tenant commands with near constant demand over a fiscal year. With the exception of rare tenant relocations or drastic increases or reductions in workforces, NAVFAC and its local vehicle program administrators can expect predictable usage over long periods.

The process flow chart for the status flow includes five activities, two of which regularly function as inventory buffers. The bulk of the vehicle inventory is maintained in the *Assigned to Customers* (#1) activity. This represents vehicles currently assigned to tenant commands in accordance with their allotment as per their IO or VAM. During a fiscal year, most vehicles will remain assigned to a command except for scheduled maintenance.

There are three identified outflows from *Assigned to Customers* that operate independently but concurrently. The first is *Scheduled Maintenance* (#2). This covers all the routine maintenance a vehicle may require. While a vehicle trip log is required to be maintained by instruction, the program is ineffective. There is no easy method to have mileage reported to NAVFAC outside of when they flow through an activity they control (i.e., not while assigned). For this reason, maintenance is scheduled based on set periods,

in this case semiannually. Vehicles undergoing scheduled maintenance are returned directly to their assigned commands.

The next concurrent outflow is *Repair Maintenance* (#3). This encompasses all unforeseen maintenance such as normal wear and tear, part failures, and vehicle accidents. While not a scheduled event, the average frequency can be used. Being nonstandard in nature repair times vary wildly.

The last concurrent activity is *Return Maintenance* (#4). Vehicles returned from assignment permanently receive a standard inspection and servicing before being made available for future assignments. Generally, there is no maintenance action taken. If a vehicle is approaching a scheduled maintenance window, it may be done early while in this activity. Rarely there will be some issue discovered during inspection that may require further investigation and/or redress from the returning command. This may cause a vehicle to be maintained in this activity long-term creating an inventory buffer.

Vehicles in the *Repair Maintenance* and *Return Maintenance* activities are returned to the unassigned inventory pool after completion. Vehicles returned to the unassigned inventory are placed in the activity *Lot*. Here vehicles are maintained in ready status for assignment and represents one of the steady inventory buffers in the process flow chart. Vehicles are issued from the lot via the *Admin/Res/Issue* activity from which they are transitioned to the *Assigned to Customer* activity. The process of issuing vehicles in negligible.

2. Alternative I: Commercial Car-Sharing

There is a multitude of commercial vendors in today's car-sharing market and the number is growing at a steady rate. Some of the major auto manufacturers are getting their hands into the sharing market, including Ford, GM, and Fiat. The first alternative selected for analysis is the use of a commercial contracted vendor. The shared vehicles would be a direct replacement for the fleet operation currently in use (there would no longer be a B-pool). The administrative and management profile would be dynamically different as well. Maintenance would be contracted to a vendor and the administrative

responsibility would be shared with a civilian company. Figure 2 provides a process flow diagram that illustrates the simplicity of using a commercial vendor on base.

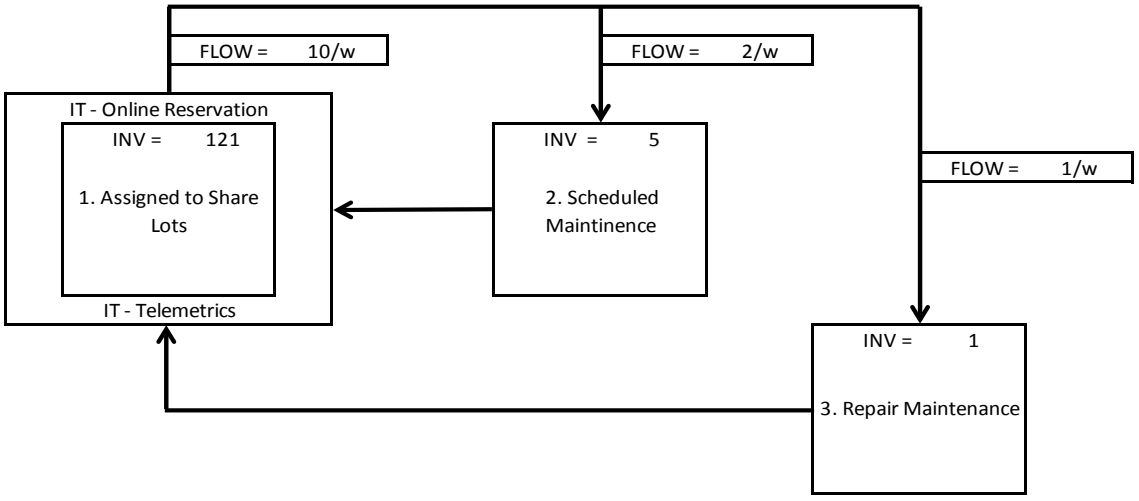

Figure 2. Commercial Car-Sharing Process Flow

From a vehicle pool standpoint, the process flow of a commercial car-sharing model has significant differences from the legacy process. The most drastic difference is there is no longer a *Lot* to stock unused vehicles for future assignments, as long-term reservations have been eliminated from the business model. The car-sharing model makes all vehicles available for immediate use in multiple lots based on demand signals from the supported tenant commands. All vehicles are located in these lots with the exceptions of those that are in use or at a maintenance activity. Essentially the *Lot* (Figure 1) exists concurrently with *Assigned to Customers* (Figure1), creating the combined inventory buffer and activity *Assigned to Share Lots* (Figure 2).

The next major difference is that there will no longer be a physical *Admin/Res/Issue* activity. Instead, an online IT application that will run concurrently with *Assigned to Share Lots*. While the application can support long lead reservations, it is equally able to support walk up reservations removing the previous need for paper or email reservations, vehicle transportation from or pick up at the *Lot,* as well as handling all of the accountability and accounting functions transparent to administrators and users.

Finally, there will no longer be a *Return Maintenance* activity, as these assets will no longer support long-term assignments. At the end of each short-term reservation, vehicles are returned directly to their lot and made available to other users. Maintenance issues previously screened for via the return process will now be reported by the next user to find unsatisfactory conditions (whether justified general issues or those attributable to the previous user that may require investigation) and treated as repair maintenance. This is made possible by the inclusion of instantaneous reporting options in the reservation application which will also handle check out and check in requirements outside the scope of the simple fob activation or automatic key box key issue.

In this option, all of the activities of the process can be contracted out to commercial entities, either in whole or in part, and the IT solutions would be leased from and operated by contractors. Vehicles would also be leased from either the same contractors or another third party.

3. Alternative II: Fleet-Sharing Software

The implementation of a commercial fleet-sharing platform is the second alternative. A fleet-sharing platform implements software and hardware for administrative and control functions while the fleet vehicles remain the responsibility of the owning/leasing agency. Figure 3 provides a process flow diagram that illustrates the process simplification gained by implementing fleet-sharing software/hardware into the existing GSA owed/leased vehicles.

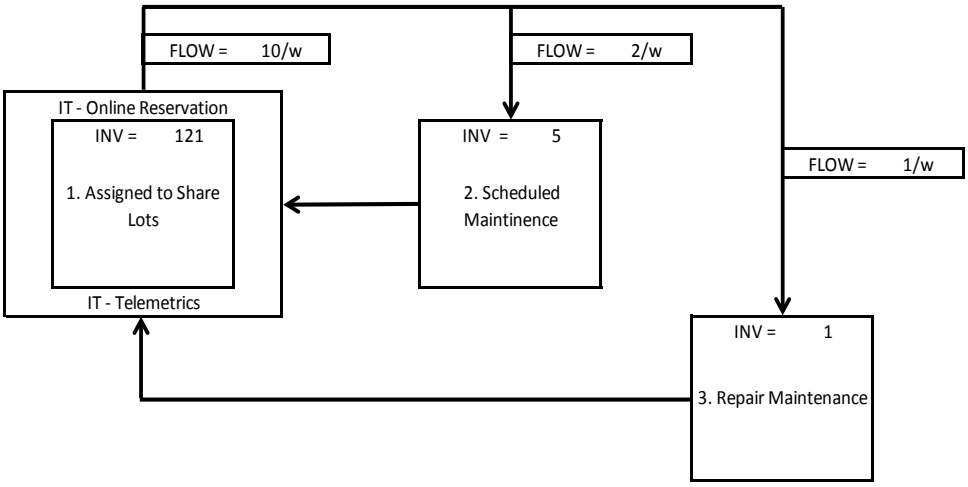

Figure 3. Fleet-Sharing Process Flow

The fleet-sharing option mimics the commercial car-sharing option. The difference is that the activities are performed by government employees utilizing government facilities and resources instead of contracted employees and that the vehicles would be government owned.

B. DECIDE WHICH COSTS AND BENEFITS COUNT

The next step in the cost-benefit analysis (CBA) framework is determining feasibility and relevancy for all costs and benefits that impact (or could impact) the public good. This CBA will be conducted using a federal government perspective and standing (whose costs and benefits will be counted) will be assigned pursuant to this perspective.

One major challenge is to analyze the data objectively without applying a political or biased lens to the CBA. The Guardian Perspective is a position, or lens, easily overlooked when viewing data from a federal financial employee viewpoint (Boardman, Greenberg, Vining, & Weimer, 2011). The Guardian tends to see the project from a simple financial viewpoint where costs equals money spent and benefits equals revenue. For financial decision making, the Guardian Perspective may seem to be beneficial on the surface, however there are significant downsides to it such as:

- It ignores non-financial social benefits such as salaried employee time or safety.
- It views subsidies from other levels of government as revenue (benefit).
- It views government owned resources as free goods vice those with an opportunity cost.

To identify who has standing with the alternatives, a stakeholder analysis is conducted using the stakeholder salience model in Figure 4 to determine who has sufficient influence, or vice versa to be counted. With regard to this study, stakeholder *power* is defined as the ability of the stakeholder to impose changes in the fleet management program (Mitchell, Agle, & Wood, 1997). Stakeholders with *legitimacy* are defined as those stakeholders who have a legitimate claim on the firm, or in this case the fleet (Mitchell et al., 1997). *Urgency* for the sake of the fleet management design, acts as a catalyst for change in the otherwise static operations. Stakeholder urgency is therefore a driving force in moving the model from static to dynamic (Mitchell et al., 1997). A *latent stakeholder* is defined as one that has one of the three attributes, an *expectant stakeholder* has two, and a *definitive stakeholder* has all three attributes.

Table 11 displays the identified stakeholders and ranks them by level of influence on the CBA alternatives. The basis for the ranking is discussed below.

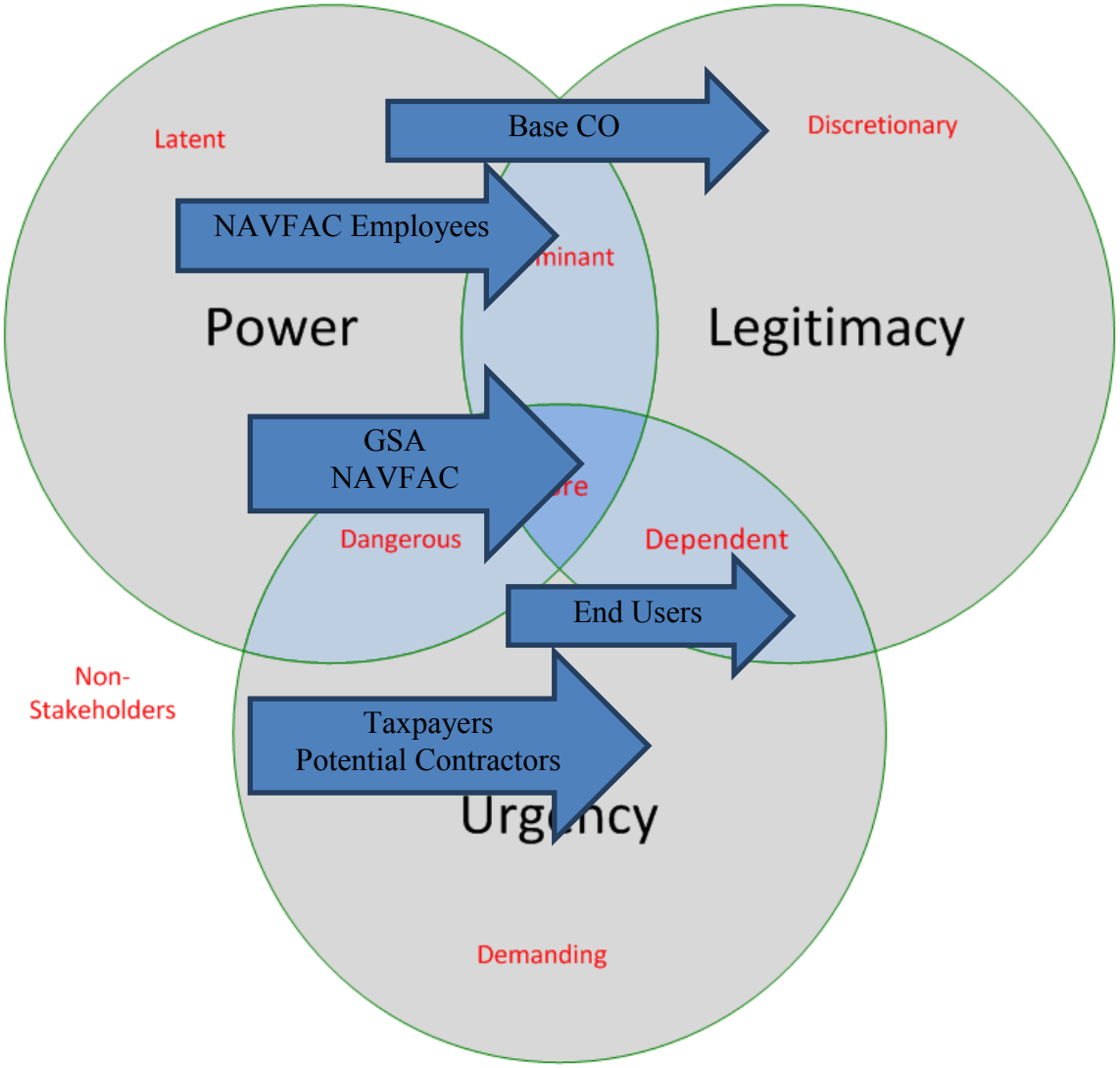

Figure 4. Stakeholder Salience Model. Adapted from Mitchell et al. (1997).

Table 11. Stakeholder Analysis. Adapted from Mitchell et al. (1997)

Stakeholder Title	Level of Influence	Stakeholder Typology
NAVFAC	High	Definitive (core)
GSA	High	Definitive (core)
Tenant Commands & Customers (End Users)	Medium	Dependent
NAVFAC Employees	Low	Dominant
Base CO (NAS Jacksonville)	Very Low	Discretionary
Potential Contractors	Very Low	Demanding
Taxpayers	Very Low	Demanding

1. NAVFAC

Identified as a definitive or core stakeholder, normally defined as an expectant stakeholder that has gained a level of urgency and is currently pursuing solutions and funding research. NAVFAC is investing resources with the goal of identifying the best alternative path for vehicle management. NAVFAC has an objective perspective towards the CBA however, and has both the most influence and the most to gain or lose based on the set of alternatives. From an entity perspective, a change in the quantity or procedure for vehicle management will directly affect the process flow model for the vehicle's life cycle.

2. GSA

Like NAVFAC, GSA is identified as a definitive stakeholder and is responsible for vehicle management. GSA is responsible for the primary purchase contracts for the Federal Government across the board. GSA has a large interest in the results of the CBA because the results at NAS JAX may influence other NAVFAC areas of responsibility

and subsequently, other GSA customers (other DOD and Federal entities that rely on GSA to procure vehicles for issuance).

3. Tenant Commands & Customers (End Users)

The end users are the vehicle operators and are identified here as dependent stakeholders. As expectant stakeholders (two attributes) however, they rely on other entities to act on their behalf because they lack the definitive power to make changes on their own. They are the shipboard operators and the shore departments. The End Users are the customers with everything to lose and everything to gain. Improving the ability to use vehicles will increase the likelihood of use while the opposite is true as well. Command mission oriented, end users do not necessarily have the power to make changes to fleet management; they will benefit from increased usability and subsequently have proven to be supportive of alternative options based on the pilots studied in Chapter II.

4. NAVFAC Employees

The NAVFAC employees associated with vehicle maintenance and management on NAS JAX consist of the BSVE administrative personnel, maintenance technicians and under Car-Sharing or Fleet-Sharing alternatives, personnel responsible for management of the vehicle IT software and hardware. Defined as *dominant stakeholders*, they not only have power to influence changes in the process infrastructure, they are also integral to the process operation itself.

5. Base Commanding Officer (CO)

The base Commanding Officer has multiple staff members under his command that require the use of government vehicles to complete their assigned missions. The CO also has a vested interest in the base real estate. All the command parking on base is under the CO's purview so any changes in the quantity of NAVFAC vehicles on the base will have an impact on the utility of the property managed by the CO. Without any significant level of urgency or legitimate power to impact the system, the CO is identified as a *discretionary stakeholder*.

6. Potential Contractors

Motivated to sell a contract to the government, contractors can be wealth of knowledge with regard to the potential for available options. Marketing and sales can have a great impact on other stakeholders; however, contractors also have zero legitimacy or power to make this happen. Due to the single source of power awarded to potential contractors, they are determined to be *demanding stakeholders* and will not be awarded standing for the purposes of this CBA.

7. Taxpayers

From a funding perspective, the American Taxpayer is the customer. Responsible for funding the Navy's vehicle management program via the Federal path for approval, the taxpayer is also the recipient of any consumer surplus or overage that accrues as a result of alternative implementation. The public is always motivated to see the government employ a new means of cost savings, however it also has minimal knowledge or actual power to make this happen. Due to Federal focus of this paper vice a National focus, the public and will not be awarded standing.

C. CATALOG OF IMPACTS AND MEASUREMENT INDICATOR SELECTION

Listing the full catalogue of impacts is the next step of the CBA process (Cellini & Kee, 2015). Assigning each impact as a cost or a benefit may be somewhat subjective prior to data analysis and therefore has to be edited throughout the course of the study. The Status Quo is not listed because it is the standard that the other two alternatives are compared against. Table 12 lists the general impact to costs by each alternative and the measurement indicator that will be weighed in future chapters.

Table 12. Impacts, Sources, and Measurements of Costs

Impact	Car-Sharing	Fleet-Sharing	Measurement Indicator
BSVE Program Costs	BSVE Rates obtained from NAVFAC SOUTHEAST NOTICE 7030	BSVE Rates obtained from NAVFAC SOUTHEAST NOTICE 7030	Dollars
Fuel Costs	Average Fuel Costs obtained from http://money.cnn.com	Not Applicable	Dollars
Additional Parking	Additional Parking derived from data obtained from www.coj.net	Additional Parking derived from data obtained from www.coj.net	Parking Spaces
Salvage Value	Salvage Value obtained from www.kbb.com	Salvage Value obtained from www.kbb.com	Dollars
Project Management, Setup & Training Costs	Project Management, Setup & Training costs obtained from TM-NAVFAC-EXWC-PW-1301	Project Management, Setup & Training costs obtained from TM-NAVFAC-EXWC-PW-1301	Dollars
Administrative Labor Costs	Administrative Labor Costs derived from data obtained from www.federalpay.org and TM-NAVFAC-EXWC-PW-1301	Administrative Labor Costs derived from data obtained from www.federalpay.org and TM-NAVFAC-EXWC-PW-1301	Dollars
Training Costs	Training Costs derived from data obtained from www.federalpay.org and www.militaryinstallations.dod.mil	Training Costs derived from data obtained from www.federalpay.org and www.militaryinstallations.dod.mil	Employee Hours
Car-Share Usage Costs	Car-Sharing Costs derived from vehicle manufacturers MSRP and data obtained from www.zipcar.com	Not Applicable	Dollars
Car-Share Membership & Application Fees	Membership & Application Fees derived from data obtained from www.zipcar.com	Not Applicable	Dollars
Car-Share Fees & Non-Cancellation Charges	Fees & Non-Cancellation Charges obtained from GSA Office of Fleet Management Commercial Car-sharing Pilot Final Report	Not Applicable	Dollars

Impact	Car-Sharing	Fleet-Sharing	Measurement Indicator
Fleet-Share Hardware Installation & Transfer Costs	Not Applicable	Hardware Costs obtained from preliminary pricing provided by Local Motion/Zipcar	Dollars
Fleet-Share Recurring Costs	Not Applicable	Recurring Costs obtained from preliminary pricing provided by Local Motion/Zipcar	Dollars
Smart Card Costs	Not Applicable	Smart Card Costs obtained from preliminary pricing provided by Local Motion/Zipcar	Dollars

1. Base Support, Vehicles and Equipment (BSVE) Program Costs

A term commonly used in the Norfolk Car-Sharing Technology Pilot Demonstration was *Right Sizing* (Cook, Ahn, & Rotty, 2013). Right Sizing refers to the fleet size adjustment made by closely observing usage and increasing or decreasing the fleet size appropriately (Cook et al., 2013). The primary benefit of the adoption of a vehicle-sharing program is the potential reduction in the size of the government vehicle fleet. A decrease in fleet size directly impacts the costs associated with vehicle procurement, depreciation, maintenance, program administration, personnel, facilities and other overhead and support costs. All of these BSVE program costs for NAS Jacksonville are captured by the NAVFAC Southeast Region BSVE billing rates established by Naval Facilities Engineering Command (NAVFAC) and promulgated in the NAVFAC SOUTHEAST NOTICE 7030 (NAVFACSENOTE 7030) FISCAL YEAR 2016 STABILIZED BILLING RATES (Naval Facilities Engineering Command Southeast [NAVFACSE], 2015).

BSVE billing rates are established annually by computing total cost by total number of units to determine monthly and hourly rates for each vehicle and equipment type managed by the NAVFAC enterprise. Tenant commands on NAS Jacksonville are then free to rent vehicles, based on their operational requirements, at these rates. B Pool

assets are longer term rentals and as such are generally rented by supported commands at the monthly BSVE rate. Therefore, throughout this CBA, all BSVE calculations will be made utilizing the appropriate monthly rate rather than the hourly rate.

The establishment of stabilized billing rates helps to insulate supported commands from unforeseen transportation cost changes, permitting the commands to more accurately forecast and budget for transportation expenses over the fiscal year (NAVFACSE, 2015). Any overages or shortfalls due to divergences between expected costs and actual costs over the fiscal year, will be absorbed by NAVFAC's working capital fund (WCF) and will be recouped or redistributed in subsequent years by adjusting the BSVE billing rates. A working capital fund is a revolving fund, which derives all of its income from operations rather than from funding appropriated by Congress. A revolving fund is designed to operate on a break-even basis over time and adjusts its annual rates accordingly (Potvin, 2010).

The BSVE stabilized billing rates are designed to encompass the total cost of the transportation services being offered by NAVFAC to its supported customers. The total cost of the service includes direct labor costs, direct non-labor costs and applied overhead costs (S. Kurup, personal communication, 29 September, 2016).

Direct labor costs are labor costs that can be directly attributed to the transportation service being offered. They are a function of available labor hours and the composite labor rate. Available labor hours are civilian hours set by workload, including straight time and overtime. They do not include leave, training, allowed time or other overhead time. The composite rates are a function of the total hourly labor cost for each employee divided by the total number of employees. This rate is calculated for each commodity type and then multiplied by the available labor hours to establish commodity labor rates (S. Kurup, personal communication, 29 September, 2016).

Non-labor costs include any costs, other than labor, that are "directly attributable to the specific product or service" (S. Kurup, personal communication, 29 September, 2016). This includes but is not limited to the rental of the vehicles from the General

Services Administration (GSA), repair parts and other materials, tools and equipment, vehicle maintenance facilities and associated utility costs, and depreciation.

Applied overhead includes all costs that cannot be directly attributed to a single product or service. This includes but is not limited to second level management, travel, training, non-maintenance facilities and other administrative costs shared by the entire NAVFAC enterprise (S. Kurup, personal communication, 29 September, 2016).

It is impossible to disaggregate individual procurement, depreciation, maintenance, administration, personnel and facility costs from the BSVE rate and determine the potential cost savings associated with each line item resulting from the adoption of a fleet right sizing alternative. Overall, the BSVE rate multiplied by the number of vehicles reduced is an appropriate measure of the aggregate cost savings to the government across all of these line items. Therefore, throughout this CBA, any reference to BSVE Program Costs will refer to the aggregate cost of vehicle procurement, depreciation, maintenance, administration, personnel and facilities associated with the current state BSVE transportation program at NAS Jacksonville.

a. Car-Share Alternative

If the commercial car-sharing alternative is selected by NAVFAC to support its NAS Jacksonville operation, then all vehicles that meet the criteria for car-sharing can be eliminated from the B Pool. This reduction in vehicles, multiplied by the appropriate monthly BSVE rates and then annualized, represents the Navy's annual reduction in spending on BSVE Program Costs resulting from the adoption of the commercial car-sharing alternative in Jacksonville. This reduction in Navy expenditures is classified as a benefit for the purposes of this paper.

b. Fleet-Share Alternative

If the fleet-sharing alternative is selected by NAVFAC to support its NAS Jacksonville operation, then those vehicles that are deemed as excess can be eliminated from the B Pool. This reduction, multiplied by the appropriate BSVE rates and then annualized, represents the Navy's annual reduction in spending on BSVE Program Costs

resulting from the adoption of fleet-sharing technology in Jacksonville. This reduction in Navy expenditures is classified as a benefit for analysis purposes.

2. Fuel Costs

Although under both the commercial car-sharing alternative and the fleet-sharing alternative the total number of government-owned-and\-managed vehicles at NAS Jacksonville is expected to decrease the number of miles driven each year by military, DOD civilian and contractor personnel is expected to remain relatively stable as travel, training and base support requirements are not impacted by the change to a new fleet management system. Per vehicle utilization and mileage will increase, but total mileage will remain the same, and therefore, fuel consumption is expected to remain constant.

a. Car-Share Alternative

If NAVFAC implements the commercial car-sharing alternative, the cost of fuel will be included in the hourly rate assessed by the commercial car-sharing vendor and will not have to be purchased separately by the government. This reduction in Navy expenditures is classified as a benefit for the purposes of this analysis.

b. Fleet-Share Alternative

If NAVFAC implements the government run fleet-share model, there will be no change in the amount of fuel purchased by the government for the vehicle fleet. Therefore, fuel costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

3. Additional Parking

Regardless of whether the commercial car-sharing option or the government run fleet-sharing option is chosen there will be an overall reduction in the number of vehicles available for government use on base. This reduction in the number of vehicles will equate to a corresponding increase in the number of parking spaces available for individual use. Parking at NAS Jacksonville, like most naval facilities, is at a premium and the additional parking freed up by a reduction in the size of the government owned

vehicle fleet has a benefit to personnel commuting to work on the air station. This benefit, measured in additional parking spaces available, will be monetized in Chapter IV and is classified as a benefit for the purposes of this project.

4. Salvage Value

Regardless of whether the commercial car-sharing option or the government run fleet-sharing option is chosen there will be an overall reduction in the requirement for government vehicles at NAS Jacksonville. The vehicles in excess of requirements can be sold at auction or transferred to another base or region.

a. Car-Share Alternative

If the commercial car-sharing alternative is selected by NAVFAC to support its NAS Jacksonville operation, then all vehicles that meet the criteria for car-sharing can be eliminated from the B Pool. This reduction in vehicles, multiplied by the appropriate salvage value of the vehicles sold at auction obtained from Kelley Blue Book represents a cash inflow for the government and is classified as a benefit for analysis purposes.

b. Fleet-Share Alternative

If the fleet-sharing alternative is selected by NAVFAC to support its NAS Jacksonville operation, then those vehicles that are deemed as excess can be eliminated from the B Pool. This reduction in vehicles, multiplied by the appropriate salvage value of the vehicles sold at auction obtained from Kelley Blue Book represents a cash inflow for the government and is classified as a benefit for the purposes of this CBA.

5. Project Management, Setup and Training Costs

Regardless of whether the commercial car-sharing option or the government run fleet-sharing option is chosen there will be costs associated with transition to the new transportation management system. These costs include the time spent by senior NAVFAC personnel managing the project or the fee paid to an outside consultant or organization if the decision is made to outsource the project management and implementation. Designated parking lots for the car-share or fleet-share vehicles will

have to be identified, re-designated and potentially reconfigured to support the program. Additional costs include the development of training material and the time spent by NAVFAC personnel training supported commands on the new system, or the fee paid to an outside organization if the decision is made to outsource these functions. The costs assigned to this category will be based on the administrative requirements observed during the fleet-share pilots at Naval Station (NAVSTA) Norfolk, NAVSTA Great Lakes and Naval Submarine Base (NSB) Bangor. These expenditures are classified as a cost for the purposes of this paper.

6. Administrative Labor Costs

Although total personnel requirements are expected to decrease with the adoption of a car-sharing or fleet-sharing model, which is captured in the BSVE Program Costs, an administrator or administrators will have to be hired or reassigned from another program to manage the overall day to day operations of the fleet-share or car-share operation. Administrators are expected to be responsible for coordination between NAVFAC, the commercial vehicle-sharing provider, the supported commands at NAS Jacksonville and the contracting officer (KO) responsible for drafting and monitoring the contract between the government and the commercial provider. It is probable that the administrators may also serve as the Contracting Officer's Representative (COR) for the oversight of this contract. The costs assigned to this category will be based on the administrative requirements observed during the fleet-share pilots at Naval Station (NAVSTA) Norfolk, NAVSTA Great Lakes and NSB Bangor. The expenditure on program administrators is classified as a cost for the purposes of this cost-benefit analysis.

7. Training Costs

The military, DOD civilian, and contractor personnel at NAS Jacksonville are currently conversant with the existing transportation system and, regardless of the new model chosen, those personnel requiring access to a government vehicle will have to be trained on the use of a new transportation system. A vehicle-sharing model includes many new features not present in the current government vehicle model including the use of an online reservation system and RFID smart cards, as well as new regulations

regarding the prompt return of vehicles and the associated fees and charges for violating vehicle-sharing rules. The additional time required for this training represents an opportunity cost because the employee is not working at his or her primary function or duty. The opportunity cost associated with training is measured in employee hours and will be monetized later in the Impact Monetization section of this CBA. It is assumed that the time requirement for employees to be trained on the new system is the same or negligibly different from the time requirement for employees to be trained on the system that is currently in place. Therefore, the costs associated with training new employees in future years as employee turnover takes place will not be considered for the purposes of this CBA as they would have been trained on the status quo transportation system had a transition to a vehicle-sharing model not taken place. The opportunity cost associated with employee training is classified as a cost for the purposes of this research paper.

8. Car-Share Usage Costs

a. Car-Share Alternative

Car-share usage costs represent the largest cost associated with the transition to a commercial car-sharing model. Under the car-sharing model, each vehicle type will be assigned an hourly rate for usage and individual commands at NAS Jacksonville will be charged based on the amount of time their personnel utilize the shared vehicles. Many of the vehicle types required by personnel at NAS Jacksonville, such as ½ ton pickup trucks and 15 passenger vans, are not currently offered by commercial car-sharing companies, so the hourly car-sharing rates that will be charged by a commercial car-sharing company were estimated using the Manufacturer's Suggested Retail Price (MSRP), the average expected life of a car-sharing vehicle and a markup to account for maintenance, fuel costs, and the vendor's profits. The expenditure on car-share usage is classified as a cost for the purposes of this CBA.

b. Fleet-Share Alternative

Car-share usage costs are not applicable in a government run fleet-share model because the government will continue to manage its own fleet. Therefore, these costs will

not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

9. Car-Share Membership and Application Fees

a. Car-Share Alternative

Commercial car-sharing companies typically charge new clients, both individuals and businesses, a one-time application fee for joining their service. There is also typically an annual membership that each client pays for the right to use the car-sharing service regardless of the number times the car-sharing service is utilized. The annual membership fee includes the initial issuance of the smart (RFID) cards that customers will need to access automobiles in the car-share program. The expenditure on car-share membership and application fees is classified as a cost for the purposes of this paper.

b. Fleet-Share Alternative

Car-share membership and application fees are not applicable in a government run fleet-share model. Therefore, these costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

10. Ca- Share Fees and Non-Cancellation Charges

a. Car-Share Alternative

Commercial car-sharing companies charge penalty fees for non-compliance with their service agreement. Table 13 lists typical penalty charges that GSA was subject to during pilot studies conducted in Washington, DC and Providence, RI.

Table 13. Fees and Penalty Charges. Source: Aiken (2016)

Fee	Enterprise	Zipcar
Late return	$50+costs incurred	$50 per hour (max $150)+costs incurred
Low fuel (less than 1/4 tank)	$25	$30
Cleaning (excessive dirt/trash, pet hair or smoking)	$50	$50
Incorrect return location	$50	NA
Replacement ignition key	$50	$75+costs incurred
Phone reservation fee	NA	$3.50 per call
Replace membership card	$10	1 free per year, $15 per each additional
Unauthorized driver	$250+membership termination	Costs incurred + membership termination
Failure to report accident, damage, theft	$50	Costs incurred + membership termination

Annual penalty charges can be significant if personnel fail to adequately plan and manage their use of the commercial car-sharing service. The expenditure on car-share fees and non-cancellation charges is classified as a cost for analysis purposes.

b. Fleet-Share Alternative

Car-share fees and non-cancellation charges are not applicable in a government run fleet-share model. Therefore, these costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

11. Fleet-Share Hardware Installation and Transfer Costs

a. Car-Share Alternative

Fleet-share hardware installation and transfer costs are not applicable in a commercial car-share model. Therefore, these costs will not be considered in the cost-benefit analysis between the car-sharing alternative and the status quo.

b. Fleet-Share Alternative

A government managed fleet-share alternative requires the installation of commercially developed telematics systems on government owned vehicles to allow fleet-share members access to reserved vehicles and to track and transmit vehicle usage data to NAVFAC transportation program managers. The commercial fleet-sharing technology provider assesses a per vehicle fee for installation of the telematics hardware. They also charge a fee to transfer the hardware from one vehicle and install it on another

as the vehicle fleet turns over and older vehicle are decommissioned. The expenditure on fleet-share hardware installation and transfer costs is classified as a cost for the purposes of this CBA.

12. Fleet-Share Recurring Costs

a. Car-Share Alternative

Fleet-share recurring costs are not applicable in a commercial car share model. Therefore, these costs will not be considered in the cost-benefit analysis between the car-sharing alternative and the status quo.

b. Fleet-Share Alternative

Commercial fleet-share technology companies charge a monthly fee for recurring services. These services and costs vary depending on the service provider but generally include lease fees for the telematics hardware installed on the vehicles, software costs and management fees for setting up and maintaining the online system that customers will use to reserve vehicles in the fleet-share program. The expenditure on fleet-share recurring costs is classified as a cost for the purposes of this cost-benefit analysis.

13. Smart Card Costs

a. Car-share Alternative

Initial issuance of smart (RFID) cards was previously accounted for as part of Car-Share Application and Membership Fees, and the issuance of replacement smart cards was accounted for as part of Car-Share Fees and Non-Cancellation Charges. Therefore, an additional smart card cost will not be considered in the cost-benefit analysis between the car-sharing alternative and the status quo.

b. Fleet-Share Alternative

Customers utilizing vehicles under a government managed fleet-share program will require an RFID card to access the vehicle. Once the vehicle is accessed via the RFID card, the customer will have access to the vehicles keys and the telematics system will come online and begin tracking the necessary data associated with the program such

as mileage, time and utilization. The RFID cards are provided by the fleet-share technology provider and the expenditure on these smart cards is classified as a cost for computation purposes.

14. Additional Impacts that were Considered but not Included

There were additional costs and benefits of vehicle sharing that were considered but not included for the purposes of this CBA because, while not negligible, due to their qualitative nature they were deemed overly difficult to measure. It was assessed that they would not significantly impact the outcome of the study. For example, many participants in the GSA car-sharing pilot conducted in Washington, DC, gained user satisfaction from the cleanliness of the car-sharing vehicles compared to government owned vehicles. Users also noted that car-share vehicle were generally newer models than comparable government vehicles. Many users also gained satisfaction from the online reservation system and the ability to make reservations at the last minute if there was a vehicle available. Other users were dissatisfied with the more stringent trip planning requirements resulting from the need to return the vehicle within the allotted reservation window (Aiken, 2016).

Other potential impacts were considered but not included because it was decided that they were not significantly altered by the adoption of a vehicle-sharing alternative or they were considered to be transfer costs. For example, because the total number of miles being driven by government vehicles remains constant whether or not a vehicle-sharing model is adopted, environmental impacts and traffic congestion were assumed to remain unchanged. The increased government spending on vehicle sharing was considered a transfer and offset by the reduced government spending on automobiles.

D. QUANTITATIVE IMPACT PREDICTION OVER PROJECT LIFE

The next step in the CBA process is to identify the relevant project life of the program and predict how both costs and benefits will change over this time period (Cellini & Kee, 2015). Information technology is an important component of this CBA. Both the hardware and software technology that enables the vehicle-sharing platforms are growing at a considerable rate, however this growth also limits the number of years that a

new model would be considered relevant. Because of the rapid development and short life cycle of technology, a five year project life has been selected for this cost-benefit analysis. From implementation to replacement, the quantitative impact will be predicted for each alternative for five consecutive years starting with a base year of FY 2017.

Many of the costs and benefits associated with implementing a car-sharing model are one-time events, which will accrue during the first year of implementation while many others will continue to accrue throughout the life of the project. For those costs and benefits that continue to accrue throughout the five year life of the project, some will remain constant on a year to year basis while other will fluctuate between years based on a variety of factors. The following analysis describes the methodology used in this study to predict the impacts on the cost and benefit drivers over the lifetime of the car-sharing project.

1. Base Support, Vehicles and Equipment (BSVE) Program Costs

Table 14 presents a year by year comparison of BSVE rates for the Navy's Southeast Region, which includes NAS Jacksonville, over a six year period. The Table includes all of the applicable B Pool vehicle types, which are currently utilized by military and civilian personnel at the air station. BSVE rates remain stable between some years and fluctuate drastically between others as NAVFAC resets the rates yearly to maintain the break-even basis of their working capital fund (WCF). The average of the annual changes over this six year period is 2.39% per year and this is the growth factor that will be used to predict BSVE changes over the five-year life of this CBA.

Table 14. BSVE Rates for Navy Region Southeast.

Vehicle Category	2011	2012	2013	2014	2015	2016
Truck, Pickup Compact 4x2	$488	$488	$488	$351	$376	$494
Truck, Pickup 4x2, Crew Cab	$640	$640	$640	$461	$493	$656
Truck, 1/2T Pickup 4x2	$536	$536	$536	$386	$413	$548
Truck, Sport Utility, Commercial, 4x2 Midsize	$688	$688	$688	$495	$530	$705
Truck, Van, 7 Pass, Compact	$496	$496	$496	$357	$382	$510
Truck, Van, 8 Pass	$520	$520	$520	$374	$401	$533
Truck, Van, 12 Pass	$536	$536	$536	$386	$413	$549
Truck, Van, 15 Pass	$552	$552	$552	$397	$425	$566
Sedan, Sub Compact	$328	$328	$328	$236	$253	$338
Sedan, Compact	$448	$448	$448	$323	$345	$459
Year to Year Change	**0.00%**	**0.00%**	**-28.02%**	**7.04%**	**32.92%**	

Adapted from E. Walter, personal communication (11 October 2016).

2. Fuel Costs

The average price of gasoline in the state of Florida in 2016 was $1.78 ("Gas prices by state," 2016). 2016 featured historically low fuel prices but it is likely that gasoline prices will increase over the lifetime of the CBA. Table 15 presents a year by year comparison of average gasoline prices in the United State between 1995 and 2015.

Table 15. Average Fuel Prices for the United States

Year	Price/Gallon	% Change
1995	1.15	
1996	1.23	6.96%
1997	1.23	0.00%
1998	1.06	-13.82%
1999	1.17	10.38%
2000	1.51	29.06%
2001	1.46	-3.31%
2002	1.36	-6.85%
2003	1.59	16.91%
2004	1.88	18.24%
2005	2.30	22.34%
2006	2.59	12.61%
2007	2.80	8.11%
2008	3.27	16.79%
2009	2.35	-28.13%
2010	2.79	18.72%
2011	3.53	26.52%
2012	3.64	3.12%
2013	3.53	-3.02%
2014	3.37	-4.53%
2015	2.45	-27.30%
Average:		5.14%

Adapted from "Fact #915: March 7, 2016 Average Historical Annual Gasoline Pump Price, 1929–2015," (2016).

The average annual change in gasoline prices over this 20-year period was an increase of 5.14%, which is the factor that will be used to predict future gasoline prices over the life of the CBA.

3. Additional Parking

The value of the additional parking realized by the adoption of a car-sharing model is calculated by the number of additional parking spaces freed up on base by the reduction in the size of the government owned vehicle fleet. This value will be monetized

in Chapter IV using an estimate of the average motorist's willingness to pay (WTP) for parking in the Jacksonville, FL area based on an average of the monthly rates at city managed parking facilities. Because only current parking prices are available and not historic prices, it is difficult to estimate or predict the average annual increase in the cost of parking in Jacksonville and as such, WTP for parking is assumed to be constant across the time frame chosen for this CBA.

4. Salvage Value

Salvage Value is a one-time benefit accruing to the Navy in the base year (2017) of adopting a vehicle-sharing model as excess vehicles are disposed of in the open marketplace.

5. Project Management, Setup and Training Costs

The cost associated with initial setup and transition to a vehicle-sharing model at NAS Jacksonville is a one-time cost that would occur in the base year (2017) of the project.

6. Administrative Labor Costs

Table 16 presents a year-by-year salary comparison for a General Schedule (GS) Grade 13 Step 5 employee in the Jacksonville, FL locality over a four-year period. The average annual change in salary over this period was an increase of 1.06%, which is the factor that will be used to predict future salaries over the life of the CBA.

Table 16. GS13 Step 5 Payscale for Jacksonville Locality.

Year	2013	2014	2015	2016
Salary	$92,732	$93,660	$94,596	$95,704
% Change		1.00%	1.00%	1.17%
Average % Change			1.06%	

Adapted from "Florida General Schedule (GS) Pay Scale for 2016," (n.d.).

7. Training Costs

Training Costs is a one-time cost associated with the transition to a new vehicle-sharing model, which will occur in the base year (2017) of the project. The opportunity cost associated with training existing employees on the new transportation model will be measured initially in employee hours lost which will be monetized in Chapter IV. It is assumed that the time requirement for employees to be trained on the new system is the same or negligibly different from the time requirement for employees to be trained on the system that is currently in place. Therefore, the costs associated with training new employees in future years as employee turnover takes place will not be considered for the purposes of this paper as they would have been trained on the status quo transportation system in any case if a transition to a vehicle-sharing model had not taken place.

8. Car-Share Usage Costs

Car-Share Usage Costs are expected to be set via a contractual vehicle between the U.S. Government (NAVFAC) and a commercial car-sharing vendor, which spans the expected five year life of the car-sharing project. As such, hourly car-sharing rates for each vehicle platform are assumed to be constant throughout the five year life cycle.

9. Car-Share Membership and Application Fees

Car-Share Membership and Application Fees are expected to be set via a contractual vehicle between the U.S. Government (NAVFAC) and a commercial car-sharing vendor, which spans the expected five year life of the car-sharing project. As such, monthly membership fees are assumed to be constant throughout the five year life cycle. The application fee is a one-time fee paid by each unit or command participating in the car-sharing program at initial sign up. The number of tenant commands onboard NAS Jacksonville requiring access to government vehicles is expect to remain constant so Application Fees are assumed to be a one-time charge to the Navy that will take place in the base year (2017) of the project.

10. Car-Share Fees and Non-Cancellation Charges

No previous vehicle-sharing pilot conducted by NAVFAC or GSA has lasted more than six months so there is no data available to verify if the costs associated with Car-Share Fees and Non-Cancellation Charges increase or decrease in subsequent years as people become more familiar with the operation and technicalities of a car-sharing system. The commercial car-sharing pilot conducted by GSA at its location in Washington, DC, noted that there was a learning curve associated with employees utilizing a car-share model, and because of this, poor trip planning was a significant factor resulting in additional fees as well as customer dissatisfaction (Aiken, 2016). Based on this observed learning curve, for the purposes of this CBA, Car Share Fees and Non-Cancellation Charges are assumed to decrease by 10% in year two of the project as people become increasingly familiar and comfortable with the system and will remain at this reduced level for the remaining life cycle of the project.

11. Fleet-Share Hardware Installation and Transfer Costs

Fleet-share hardware installation and transfer costs are expected to be set via a contractual vehicle between the U.S. Government (NAVFAC) and a commercial fleet-sharing technology vendor, which spans the expected five year life of the fleet-sharing project. As such, per vehicle hardware installation and transfer costs are assumed to be constant throughout the five year life cycle.

12. Fleet-Share Recurring Costs

Fleet-Share Recurring Costs are expected to be set via a contractual vehicle between the U.S. Government (NAVFAC) and a commercial fleet-sharing technology vendor, which spans the expected five year life of the fleet-sharing project. As such, monthly recurring costs per vehicle are assumed to be constant throughout the five year life cycle.

13. Smart Card Costs

The price per each individual smart card is expected to be set via a contractual vehicle between the U.S. Government (NAVFAC) and a commercial fleet-sharing technology vendor, which spans the expected five year life of the fleet-sharing project.

As such, the unit cost for each smart card is assumed to remain constant throughout the five year life cycle. The initial purchase of smart cards for base personnel is a one-time cost that will occur in the base year (2017) of the project. Base population requiring access to a government vehicle is conservatively estimated to be 50% and annual turnover of base personnel is conservatively estimated to be 5%. This entails that the navy will have to procure a smart card for 2.5% of personnel on base every year following the base year.

E. IMPACT MONETIZATION

The next step in the CBA process after projecting the costs and the benefits over the program period is to monetize (attach a dollar figure) the associated costs and benefits of the project over the entire project life cycle (Cellini & Kee, 2015). The impacts to be monetized include BSVE program costs, fuel costs, the value of additional parking spaces made available, salvage value, project management, setup & training costs, administrative labor costs, training costs, car-share usage costs, car-share application and membership fees, car-share fees & non-cancellation charges, fleet-share hardware installation and transfer costs, fleet-share recurring costs and smart card costs.

1. Base Support Vehicle and Equipment (BSVE) Program Costs

If the commercial car-sharing alternative is selected, eligible vehicles will be removed from inventory and the BSVE savings experienced by supported commands over the five year life cycle of this study represents a significant cost savings to the Navy and to NAVFAC Southeast. Using the 2016 BSVE rates promulgated in NAVFACSENOTE 7030 (NAVFACSE, 2015) and the breakdown of vehicles eligible for car-sharing calculated in the Methodology section of this CBA, Table 17 represents how the theoretical BSVE savings, in current year dollars, can be calculated for 2016.

Table 17. Car-Sharing Annual Savings from reduced BSVE Program Costs (CY$).

Vehicle Category	Vehicle Reduction	2016 BSVE Rate (Monthly)	Annual Savings (2016)
Truck, Pickup Compact 4x2	17	$494	$100,776
Truck, Pickup 4x2, Crew Cab	32	$656	$251,904
Truck, 1/2T Pickup 4x2	7	$548	$46,032
Truck, Sport Utility, Commercial, 4x2	2	$705	$16,920
Truck, Van, 7 Pass, Compact	24	$510	$146,880
Truck, Van, 8 Pass	5	$533	$31,980
Truck, Van, 12 Pass	12	$549	$79,056
Truck, Van, 15 Pass	12	$566	$81,504
Sedan, Sub Compact	2	$338	$8,112
Sedan, Compact	8	$459	$44,064
Total (CY$):	**121**		**$807,228**

Using the 2.39% BSVE growth factor calculated in the Quantitative Impact Prediction section of this CBA, BSVE Program cost savings can now be projected for the five year life of the project starting in the base year (2017). Table 18 shows all calculations for current year (CY) dollars.

Table 18. Car-Sharing Savings from Reduced BSVE Program Costs Over Project Life (CY$).

Vehicle Category	2017 (CY$)	2018 (CY$)	2019 (CY$)	2020 (CY$)	2021 (CY$)
Truck, Pickup Compact 4x2	$103,185	$105,651	$108,176	$110,761	$113,408
Truck, Pickup 4x2, Crew Cab	$257,925	$264,089	$270,401	$276,863	$283,480
Truck, 1/2T Pickup 4x2	$47,132	$48,259	$49,412	$50,593	$51,802
Truck, Sport Utility, Commercial, 4x2	$17,324	$17,738	$18,162	$18,596	$19,041
Truck, Van, 7 Pass, Compact	$150,390	$153,985	$157,665	$161,433	$165,291
Truck, Van, 8 Pass	$32,744	$33,527	$34,328	$35,149	$35,989
Truck, Van, 12 Pass	$80,945	$82,880	$84,861	$86,889	$88,966
Truck, Van, 15 Pass	$83,452	$85,446	$87,489	$89,580	$91,721
Sedan, Sub Compact	$8,306	$8,504	$8,708	$8,916	$9,129
Sedan, Compact	$45,117	$46,195	$47,299	$48,430	$49,587
Total (CY$):	**$826,521**	**$846,275**	**$866,501**	**$887,210**	**$908,414**

As discussed, for the purposes of this CBA BSVE Program Costs represent an approximation of all of the direct labor, direct material and applied overhead costs associated with the NAVFAC vehicle program at NAS Jacksonville and also represents the largest area of potential cost savings resulting from the adoption of a vehicle-sharing strategy. Because the 121 eligible vehicles are no longer required under this option, it will no longer be necessary for NAVFAC to procure new vehicles to meet customer requirements so the associated depreciation, maintenance, personnel, administrative and facilities costs associated with these vehicles are also no longer relevant and represent cost savings for the Navy.

If the government managed fleet-sharing alternative is selected, the government will retain the 54 vehicles recommended in the Methodology section of this CBA and dispose of the vehicles in excess of this number. The BSVE savings experienced by supported commands over the five year life cycle of this study represents a significant cost savings for the Navy. The number and types of vehicles for disposal are presented in Table 19.

Table 19. Fleet-Sharing Number of Vehicles Selected for Salvage.

Vehicle Category	Current Fleet Size	Optimum Fleet Size	Vehicle Reduction
Truck, Pickup Compact 4x2	17	6	11
Truck, Pickup 4x2, Crew Cab	32	11	21
Truck, 1/2T Pickup 4x2	7	2	5
Truck, Sport Utility, Commercial, 4x2 Midsize	2	1	1
Truck, Van, 7 Pass, Compact	24	11	13
Truck, Van, 8 Pass	5	5	0
Truck, Van, 12 Pass	12	6	6
Truck, Van, 15 Pass	12	7	5
Sedan, Sub Compact	2	1	1
Sedan, Compact	8	4	4
Total:	**121**	**54**	**67**

Using the vehicle reduction number predicted in Table 19 and the 2016 BSVE rates promulgated in NAVFACSENOTE 7030 (NAVFACSE, 2015), Table 20 shows how the theoretical BSVE savings in current year dollars, can be calculated for 2016.

Table 20. Fleet-Sharing Annual Savings from Reduced BSVE Program Costs (2016$).

Vehicle Category	Vehicle Reduction	2016 BSVE Rate (Monthly)	Annual Savings (2016)
Truck, Pickup Compact 4x2	11	$494	$65,208
Truck, Pickup 4x2, Crew Cab	21	$656	$165,312
Truck, 1/2T Pickup 4x2	5	$548	$32,880
Truck, Sport Utility, Commercial, 4x2	1	$705	$8,460
Truck, Van, 7 Pass, Compact	13	$510	$79,560
Truck, Van, 8 Pass	0	$533	$0
Truck, Van, 12 Pass	6	$549	$39,528
Truck, Van, 15 Pass	5	$566	$33,960
Sedan, Sub Compact	1	$338	$4,056
Sedan, Compact	4	$459	$22,032
Total (CY$):	**67**		**$450,996**

Using the 2.39% BSVE growth factor calculated in the Quantitative Impact Prediction section of this CBA, Table 21 shows how BSVE Program cost savings can be projected for the five year life of the project starting in the base year (2017). All calculations are in current year (CY) dollars.

Table 21. Fleet-Sharing Savings from Reduced BSVE Program Costs over Project Life (CY$).

Vehicle Category	2017 (CY$)	2018 (CY$)	2019 (CY$)	2020 (CY$)	2021 (CY$)
Truck, Pickup Compact 4x2	$66,766	$68,362	$69,996	$71,669	$73,382
Truck, Pickup 4x2, Crew Cab	$169,263	$173,308	$177,450	$181,691	$186,034
Truck, 1/2T Pickup 4x2	$33,666	$34,470	$35,294	$36,138	$37,002
Truck, Sport Utility, Commercial, 4x2	$8,662	$8,869	$9,081	$9,298	$9,520
Truck, Van, 7 Pass, Compact	$81,461	$83,408	$85,402	$87,443	$89,533
Truck, Van, 8 Pass	$0	$0	$0	$0	$0
Truck, Van, 12 Pass	$40,473	$41,440	$42,430	$43,445	$44,483
Truck, Van, 15 Pass	$34,772	$35,603	$36,454	$37,325	$38,217
Sedan, Sub Compact	$4,153	$4,252	$4,354	$4,458	$4,564
Sedan, Compact	$22,559	$23,098	$23,650	$24,215	$24,794
Total (CY$):	**$461,775**	**$472,811**	**$484,111**	**$495,682**	**$507,528**

2. Fuel Costs

As previously discussed, the average number of miles driven by government vehicles at NAS Jacksonville is expected to remain steady throughout the five year time frame of this project regardless of whether or not a vehicle-sharing alternative is selected. From the data provided by MAXIMO the average number of miles driven by the 121 vehicle-sharing eligible vehicles in Jacksonville in a given year is 350,758, which will be the annual mileage figure used for the remainder of this CBA. Using miles per gallon (mpg) ratings obtained from the U.S. Department of Energy (U.S. Department of Energy: Office of Transportation and Air Quality, n.d.) for each year and make and model in the NAVFAC fleet, an average MPG per vehicle category can be calculated. Multiplying the average annual mileage by the average MPG provides an estimate of 21,200 gallons of gasoline consumed annually by the 121 eligible vehicles. Table 22 provides a breakdown of the annual mileage, miles per gallon and gasoline consumption per vehicle category.

Table 22. Annual Fuel Consumption per Vehicle Type.

Vehicle Category	Avg. Annual Mileage	Avg. mpg	Gasoline Consumption (gallons/year)
Truck, Pickup Compact 4x2	41,574	21	1,980
Truck, Pickup 4x2, Crew Cab	68,448	15	4,563
Truck, 1/2T Pickup 4x2	13,069	16	817
Truck, Sport Utility, Commercial, 4x2	5,437	32	170
Truck, Van, 7 Pass, Compact	71,587	20	3,579
Truck, Van, 8 Pass	31,897	14	2,278
Truck, Van, 12 Pass	41,267	13	3,174
Truck, Van, 15 Pass	46,497	13	3,577
Sedan, Sub Compact	5,605	30	187
Sedan, Compact	25,377	29	875
Total:	**350,758**		**21,200**

Using the average price of a gallon of gasoline in the state of Florida in 2016 ($1.78) ("Gas prices by state," 2016) and the annual growth factor for fuel prices (5.14%) calculated in the Quantitative Prediction section of this CBA, an estimated average gasoline price per gallon for each year of the project can be calculated. Multiplying the annual estimated gasoline price by the annual estimated gasoline consumption of 21,200 provides a prediction of fuel costs over the full five year term of the project in current year (CY) dollars. Table 23 presents the predicted fuel costs over the five year project life if the car-sharing strategy is not chosen and NAVFAC maintains the status quo. If the car-share alternative is chosen, fuel costs will be incorporated into the hourly rental charge for the shared vehicles and the predicted fuel costs will represent a cost savings for the Navy.

Table 23. Total Fuel Costs assuming 5.14% Annual Growth in Fuel Prices (CY$).

Year	Gallons	P/gal	Total Cost (CY$)
2017	21,200	1.87	$39,676
2018	21,200	1.97	$41,715
2019	21,200	2.07	$43,859
2020	21,200	2.18	$46,113
2021	21,200	2.29	$48,484

If the fleet-sharing alternative is chosen, the Navy will still be responsible for procuring gasoline for the supported vehicles. The number of vehicles supported will decrease from 121 to 54 but the total number of miles driven will remain the same 21,200 as noted in Table 22, so the Navy's total expenditure on fuel will not change. Therefore, fuel costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

3. Additional Parking

If either of the vehicle-sharing alternatives is chosen for implementation, the government motor vehicle fleet at NAS Jacksonville will shrink from 121 vehicles to 54 vehicles, a net decrease of 67 vehicles. This reduction in vehicles equates to an additional 67 parking spaces on base that could be available for sailors, DOD civilians and contractors to park their personally operated vehicles (POV). These 67 additional parking spaces represent a net benefit for everyone who works on base, but this benefit, which is currently measured in parking spaces, must be converted to dollars to fit into the framework of this CBA.

Table 24. Monthly Rates at City Managed Parking Facilities.

Parking Facility	Monthly Rate
Bay & Ocean Lot	$53.50
Ed Ball Garage	$85.60
Forsyth St. Lot	$85.60
Library Garage	$68.48
Water St. Garage	$53.50
Yates Garage	$53.50
Avg. Price (Monthly):	$66.70
Avg. Price (Annual):	**$800.36**

Adapted from "Jacksonville CITY-MANAGED DOWNTOWN PUBLIC PARKING FACILITIES," (2016).

The monthly parking rates for the six public parking garages managed by the City of Jacksonville are listed in Table 24. The average monthly rate of these public parking facilities is $66.70. Annualized the rate is $800.36 which will be used as an estimate of the average consumer's willingness to pay (WTP) for parking in the Jacksonville area for the purposes of this CBA. Table 25 below displays the net benefit to the NAS Jacksonville community of the 67 additional parking spaces over the five year project life in current year dollars.

Table 25. Benefit of Additional Parking (WTP).

Year	Additional Parking Spots	WTP (Annual)	Total Benefit (CY$)
2017	67	$800.36	$53,624
2018	67	$800.36	$53,624
2019	67	$800.36	$53,624
2020	67	$800.36	$53,624
2021	67	$800.36	$53,624

4. Salvage Value

If the commercial car-sharing alternative is chosen, NAVFAC will be able to dispose of the 121 eligible vehicles on the open market and the salvage value of these vehicles represents a significant one-time monetary benefit to the Navy. Salvage values were calculated using 2016 Kelley Blue Book (KBB) values for the make, model and year for each of the 121 eligible vehicles. As 2017 KBB vehicle values are not yet available, 2016 valuations were deemed a reasonable approximation, based on historically low inflation rates and the relatively low number of additional miles expected to be driven for each vehicle type based on historical data displayed in Table 26.

Table 26. Average Annual Vehicle Mileage by Category.

Average Annual Vehicle Mileage by Category	
Vehicle Category	**Avg. Mileage (Annual)**
Truck, Pickup Compact 4x2	2,446
Truck, Pickup 4x2, Crew Cab	2,139
Truck, 1/2T Pickup 4x2	1,867
Truck, Sport Utility, Commercial, 4x2	2,719
Truck, Van, 7 Pass, Compact	2,983
Truck, Van, 8 Pass	6,379
Truck, Van, 12 Pass	3,439
Truck, Van, 15 Pass	3,875
Sedan, Sub Compact	2,802
Sedan, Compact	3,172

Adapted from "Jacksonville CITY-MANAGED DOWNTOWN PUBLIC PARKING FACILITIES," (2016).

For the purposes of valuation, all of the vehicles were conservatively assumed to be in "good" condition, which is the second lowest of the four categories used by KBB. It was also assumed that the vehicles would be disposed of in the Jacksonville locality (zip code 32212). The average mileage per vehicle for each category of vehicle, per Table 27 was calculated using the individual mileage for each vehicle over a three year period

extracted from MAXIMO (S. Kurup, personal communication, 13 September 2016) and these average mileage figures were used to estimate salvage value.

Table 27. Average Total Vehicle Mileage by Category.

Vehicle Category	Total Mileage	# of Vehicles	Avg. Mileage (per vehicle)
Truck, Pickup Compact 4x2	247,554	17	14,562
Truck, Pickup 4x2, Crew Cab	659,768	32	20,618
Truck, 1/2T Pickup 4x2	89,121	7	12,732
Truck, Sport Utility, Commercial, 4x2	43,498	2	21,749
Truck, Van, 7 Pass, Compact	323,787	24	13,491
Truck, Van, 8 Pass	122,408	5	24,482
Truck, Van, 12 Pass	114,201	12	9,517
Truck, Van, 15 Pass	205,454	12	17,121
Sedan, Sub Compact	23,750	2	11,875
Sedan, Compact	141,076	8	17,635
Total:	1,970,617	121	

Adapted from ("Kelly Blue Book - New and Used Car Price Value, Expert Car Reviews," n.d.).

Benefits from salvaging vehicles are expected to accrue in the base year (2017) of initiating the car-sharing program. It was conservatively assumed for the purposes of this CBA that the government vehicles would sell in the marketplace for 15% below the market value assigned them by KBB. This discounted rate is used to account for variations in market conditions as well as vehicle conditions and the fact that 2016 KBB vehicle valuations had to be used to approximate future values in 2017. Table 28 represents the net salvage value expected to accrue to the Navy in 2017 calculated in FY17 dollars.

Table 28. Net Salvage Value (FY$) for Car-Sharing Alternative.

Vehicle Category	Avg Per Vehicle Salvage Value	Vehicle Reduction	Salvage Value (Market)	Salvage Value (15% Below Market)
Truck, Pickup Compact 4x2	$10,484	17	$178,228	$151,493.80
Truck, Pickup 4x2, Crew Cab	$14,563	32	$466,016	$396,113.60
Truck, 1/2T Pickup 4x2	$10,290	7	$72,030	$61,225.50
Truck, Sport Utility, Commercial, 4x2	$9,384	2	$18,768	$15,952.80
Truck, Van, 7 Pass, Compact	$12,032	24	$288,768	$245,452.80
Truck, Van, 8 Pass	$14,895	5	$74,475	$63,303.75
Truck, Van, 12 Pass	$19,819	12	$237,828	$202,153.80
Truck, Van, 15 Pass	$17,096	12	$205,152	$174,379.20
Sedan, Sub Compact	$8,146	2	$16,292	$13,848.20
Sedan, Compact	$8,128	8	$65,024	$55,270.40
Total (FY17$):		**121**	**$1,622,581**	**$1,379,194**

Adapted from S. Kurup, personal communication, (13 September, 2016) & "Kelly Blue Book - New and Used Car Price Value, Expert Car Reviews," (n.d.)

If the government managed fleet-sharing option is selected NAVFAC will be able to dispose of 67 vehicles on the open market. Salvage values were calculated using the identical criteria discussed under the car-sharing alternative. The only difference is the reduction in the number of vehicles being salvaged from 121 to 67. Table 29 represents the net salvage value expected to accrue to the Navy in 2017 calculated in FY17 dollars.

Table 29. Net Salvage Value (FY$) for Fleet-Sharing Alternative.

Vehicle Category	Avg Per Vehicle Salvage Value	Vehicle Reduction	Salvage Value (Market)	Salvage Value (15% Below Market)
Truck, Pickup Compact 4x2	$10,484	11	$115,324	$98,025.40
Truck, Pickup 4x2, Crew Cab	$14,563	21	$305,823	$259,949.55
Truck, 1/2T Pickup 4x2	$10,290	5	$51,450	$43,732.50
Truck, Sport Utility, Commercial, 4x2	$9,384	1	$9,384	$7,976.40
Truck, Van, 7 Pass, Compact	$12,032	13	$156,416	$132,953.60
Truck, Van, 8 Pass	$14,895	0	$0	$0.00
Truck, Van, 12 Pass	$19,819	6	$118,914	$101,076.90
Truck, Van, 15 Pass	$17,096	5	$85,480	$72,658.00
Sedan, Sub Compact	$8,146	1	$8,146	$6,924.10
Sedan, Compact	$8,128	4	$32,512	$27,635.20
Total (FY17$):		**67**	**$883,449**	**$750,932**

5. Project Management, Setup and Training Costs

Project management, setup and training costs represent a one-time charge to be accounted for in the initial year of the vehicle-sharing program. The historical costs observed for these activities during the Navy's 2013 car-sharing technology pilot at NAVSTA Norfolk, NAVSTA Great Lakes and Naval Submarine Base (NSB) Bangor were approximately $25,000 for each location ("Historical Inflation Rates 1914–2016," n.d.). This figure has been adjusted using historical U.S. inflation rates, listed in Table 30, to come up with an approximate project management, setup and training cost of $26,091 in 2017.

Table 30. Historic Inflation Rates. Adapted from Historical Inflation Rates 1914–2016 (n.d.)

Historic Inflation Rates	
Year	Inflation Rate
2013	1.50%
2014	1.60%
2015	0.10%
2016 (JAN-SEP)	1.10%

6. Administrative Labor Costs

The first step in monetizing the additional administrative labor costs associated with managing the day to day operations of a vehicle-sharing program is determining the total number of required administrators. Table 31 displays the hourly management requirements observed during NAVFAC's car-sharing technology pilot demonstrations conducted at NAVSTA Norfolk and NAVSTA Great Lakes and uses that data to calculate a per vehicle hourly requirement for each locality.

Table 31. Administrative Labor Hours at Norfolk and Great Lakes Pilots. Adapted from Cook et al. (2013)

Pilot	Hours (Weekly)	Hours (Annual)	Vehicles	Hrs/Vehicle (Annual)
NAVSTA Norfolk Pilot	15	780	24	32.5
NAVSTA Great Lakes Pilot	15	780	13	60

Based on the observed time requirements at both locations being the same even though the pilot site at Norfolk contained almost twice as many test vehicles there is not a direct correlation between number of vehicles and required hours. The 32.5 hours per vehicle was chosen as the factor for conducting estimates at NAS Jacksonville because this was considered to be more representative than the 60 hours per vehicle observed in Great Lakes. The calculation for total required hours for NAS Jacksonville using the metric of 32.5 hours per vehicle is displayed in Table 32. The estimate of 1755 required

annual hours is reasonably close to the 2016 average annual working hours per employee previously calculated. Therefore, one additional administrator specific to the vehicle-sharing project is expected to be required if a vehicle-sharing alternative is adopted.

Table 32. Calculated Vehicle Administrative Time Costs.

Hrs/Vehicle (Annual)	Vehicles	Total Hours (Annual)
32.5	54	1755

As this administrative position is responsible for oversight of the entire vehicle-sharing program and for high level coordination between various entities both on and off base a general schedule rank of GS-13 step 5 was selected as a likely pay scale for the newly established billet. The 2016 annual salary for a GS-13 step 5 position in the Jacksonville locality is $95,704. Using the GS pay scale growth factor of 1.06% calculated during the quantitative impact prediction step, an estimate of administrator salaries can be calculated over the project's life. These costs, in CY dollars, are displayed in Table 33.

Table 33. GS13 Step5 Pay Scale for Jacksonville, FL.

Year	2017	2018	2019	2020	2021
Salary (CY$)	$96,718	$97,744	$98,780	$99,827	$100,885
% Change		1.06%	1.06%	1.06%	1.06%

Adapted from "Florida General Schedule (GS) Pay Scale for 2016," (n.d.)

7. Training Costs

The implementation of either new transportation model at NAS Jacksonville will result in the need to train existing employees on the new system. The opportunity cost associated with a large number of employees attending additional training instead of working at their normal duties represents a significant cost associated with implementing a vehicle-sharing alternative. This cost, which is measured in hours of labor lost, will be monetized to fit into the framework of this CBA. This is considered a one-time cost

accounted for in the base year of 2017 because it is assumed that in the future, this training will replace any current training that is held on the use of government vehicles and all future employees will receive this new training vice training on the previous system.

The first step in determining the opportunity cost associated with training is calculating the number of employees at Jacksonville that currently use government vehicles and will therefore be required to receive the training on the newly implemented vehicle-sharing model. Unfortunately, there was no data available on the number of people that utilize government vehicles, however infrequently, in the execution of their assigned duties and therefore assumptions have to be made in determining this figure. The total military, civilian and contractor working population at NAS Jacksonville is 18,700 ("Naval Air Station Jacksonville, Florida," n.d.). It is assumed that 50% of the working population will require access to a government vehicle in the performance of their duties at some time and will therefore be required to receive the training. This equates to 9,350 employees requiring the additional training (see Table 34).

Table 34. Initial Employee Enrollment Estimates.

Initial Employee Enrollment	
Employee Category	**Enrollment**
DoD Military Employees	10,200
DoD Civilian Employees	6,000
Contract Employees	2,500
Total Employees	18,700
% of Employees Enrolled in Program	50%
Estimate of Initial Enrollment:	**9,350**

Adapted from "Naval Air Station Jacksonville, Florida," (n.d.)

The implementation of the vehicle-sharing pilots at NAVSTA Norfolk, NAVSTA Great Lakes and NSB Bangor required 1-hour employee training sessions and this is the time requirement that will be used to determine training requirements at NAS

Jacksonville. The total opportunity cost of the additional required training is 9,350 employee hours.

To monetize 9,350 employee hours a value has to be established for an employee hour. The average employee grade at NAS Jacksonville is estimated to be a GS-11 step 5, which has an FY16 salary of $67,145 ("Florida General Schedule (GS) Pay Scale for 2016," n.d.). Using the 1.06% GS pay scale growth rate previously calculated the estimated salary for FY17 is $67,857, which equates to an employee hour cost of $33.66 (see Table 35), once again assuming 2016 work hours in a fiscal year.

Table 35. Calculated Hourly Cost for a GS-11 Step 5.

Estimated FY17 Annual Salary of GS11 step 5 Employee in JAX:	$67,857
Annual Work Hours	2016
$/Hour (FY17$)	$33.66

Adapted from "Florida General Schedule (GS) Pay Scale for 2016," (n.d.)

The total estimated cost of the additional training in FY17 dollars is the 9,350 lost employee hours multiplied by the $33.66 calculated cost of an employee hour which totals $314,721 (see Table 36).

Table 36. Calculated Training Costs assuming 50% Enrollment.

Year	Employee Enrollment	Training Time (hrs)	Employee Training Hours	Cost per Employee Hour	Total Training Costs
2017	9,350	1	9,350	$33.66	$314,721

8. Car-Share Usage Costs

Car-share usage costs refer to the total hourly fees tenant commands on NAS Jacksonville would pay over the project life for the use of the shared vehicles. It is very difficult to determine the total car-share usage costs assumed by the Navy and the tenant commands because many of the vehicle types required by the Navy, including 12

passenger vans and pickup trucks with crew cabs, are not currently offered by Zipcar or other commercial car-sharing vendors ("Atlanta car-sharing rates & plans," n.d.). Atlanta Zipcar data was used because it was the closest available locality to Jacksonville. Hourly rates were estimated by using data available for six available Zipcar vehicle categories and calculating an hourly rate to MSRP ratio for each (see Table 37). The U.S. government traditionally procures baseline vehicle without upgrades, added extras or amenities so the baseline MSRP, per the manufacturer's website was used for each vehicle.

Table 37. Ratio of Hourly Rate to Vehicle MSRP.

Make & Model	Vehicle Category	Hourly Rate	MSRP	Ratio
Nissan Frontier	Truck, Pickup Compact 4x2	13.25	$18,290	0.00072444
Ford Escape	Truck, Sport Utility, Commercial, 4x2	11.75	$23,600	0.000497881
Honda Odyssey	Truck, Van, 7 Pass, Compact	13.25	$29,550	0.000448393
Ford Transit 150	Truck, Van, 8 Pass	16.75	$31,610	0.000530
Ford Focus	Sedan, Sub Compact	8.75	$17,225	0.000507983
Toyota Corolla	Sedan, Compact	9.75	$17,300	0.000563584
Average:				**0.000545363**

Adapted from ("Atlanta car sharing rates & plans," n.d.), ("New Cars from Ford," n.d.), ("New Toyota Cars for 2016 & 2017," n.d.), ("Build and Price a Honda," n.d.), & ("Build & Price a Nissan," n.d.)

The average of all of these ratios, 0.000545, was then used to convert the MSRP to an hourly car-sharing rate for a representative vehicle typically procured by the Navy for each vehicle category. Once again, baseline MSRPs were used for these calculations, which are represented in Table 38 below.

Table 38. Calculated Car-Sharing Hourly Rates.

Make & Model	Vehicle Category	MSRP	Ratio	Car Sharing Rate (Hourly)
Toyota Tacoma	Truck, Pickup Compact 4x2	$24,120	0.000545	$13.15
Ford F150 Crew Cab	Truck, Pickup 4x2, Crew Cab	$31,905	0.000545	$17.39
Ford F150	Truck, 1/2T Pickup 4x2	$26,540	0.000545	$14.46
Ford Escape	Truck, Sport Utility, Commercial, 4x2	$23,600	0.000545	$12.86
Dodge Grand Caravan	Truck, Van, 7 Pass, Compact	$23,595	0.000545	$12.86
Ford Transit 150	Truck, Van, 8 Pass	$31,610	0.000545	$17.23
Chevrolet Express G2500	Truck, Van, 12 Pass	$33,985	0.000545	$18.52
Chevrolet Express G3500	Truck, Van, 15 Pass	$36,280	0.000545	$19.77
Ford Focus	Sedan, Sub Compact	$17,225	0.000545	$9.39
Chevrolet Malibu Hybrid	Sedan, Compact	$21,680	0.000545	$11.82

Adapted from ("New Cars from Ford," n.d.), ("Chevrolet Cars, Trucks, SUVs, Crossovers and Vans," n.d.), ("Dodge Official Site - Muscle Cars & Sports Cars," n.d.), ("New Toyota Cars for 2016 & 2017," n.d.)

The appropriate calculated hourly rate was then applied to the average annual miles driven for each vehicle category, derived from the data provided by MAXIMO for the NAS Jacksonville government vehicle fleet and converted to hours using the previously derived factor for converting mileage to hours. The expected annual cost in CY dollars over the life cycle of the project is $885,804 (see Table 39).

Table 39. Calculated Annual Car-Sharing Costs

Vehicle Category	Average Miles (Annual)	Average Hours/Mile	Total Hours (Annual)	Car Sharing Rate (Hourly)	Car Sharing Costs (Annual)
Truck, Pickup Compact 4x2	41,574	0.14	5,820	$13.15	$87,988
Truck, Pickup 4x2, Crew Cab	68,448	0.14	9,583	$17.39	$191,620
Truck, 1/2T Pickup 4x2	13,069	0.14	1,830	$14.46	$30,434
Truck, Sport Utility, Commercial, 4x2	5,437	0.14	761	$12.86	$11,259
Truck, Van, 7 Pass, Compact	71,587	0.14	10,022	$12.86	$148,210
Truck, Van, 8 Pass	31,897	0.14	4,466	$17.23	$88,470
Truck, Van, 12 Pass	41,267	0.14	5,777	$18.52	$123,059
Truck, Van, 15 Pass	46,497	0.14	6,510	$19.77	$148,018
Sedan, Sub Compact	5,605	0.14	785	$9.39	$8,471
Sedan, Compact	25,377	0.14	3,553	$11.82	$48,275
Total (CY$):					**$885,804**

Adapted from (S. Kurup, personal communication, 13 September 2016).

Car-share usage costs are not applicable to the government run fleet-sharing alternative. Therefore, these costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

9. Car Share Application and Membership Fees

Commercial car-sharing companies charge businesses and organizations a one-time application fee to join their service. This is a one-time cost that is accounted for in the base year (2017) of program implementation. The application fee for the two largest commercial car-sharing providers in the United States, Zipcar and Enterprise Car Share, are $25 and $20 respectively ("Atlanta car sharing rates & plans," n.d.) ("Tampa Community Car Sharing and Hourly Car Rental," n.d.). This gives an average application fee between the two car-sharing services of $22.50. Per the data retrieved from MAXIMO, there are 23 individual commands that would need access to the car-sharing program, which equals a total application fee in NAS Jacksonville of $518 in FY17 dollars (see Table 40).

Table 40. Calculated Car-Sharing Application Fee for NAS, Jacksonville.

Year	# of Commands:	One-time Application Fee:	Total Cost
2017	23	$22.50	$518

Adapted from S. Kurup, personal communication, (13 October 2016)

Commercial car-sharing companies also charge monthly membership fees for belonging to their service. The monthly membership fee for the two largest commercial car-sharing providers in the United States, Zipcar and Enterprise Car Share, are $50 and $30 per command respectively ("Atlanta car sharing rates & plans," n.d.) ("Tampa Community Car Sharing and Hourly Car Rental," n.d.), which gives an average monthly membership fee of $42.50. It is assumed that on average each of the 23 commands will require five memberships to be shared among their employees to meet mission requirements. It is also assumed that the $42.50 membership fee will not change in future years because of the five year contract established between the car-sharing provider and the government. The total annual expense for membership fees is $58,650 in CY dollars (see Table 41).

Table 41. Estimated Annual Membership Fees.

Year	# of Commands:	Memberships per Command	Membership Fee	Annual Cost (CY$)
2017	23	5	$42.50	$58,650
2018	23	5	$42.50	$58,650
2019	23	5	$42.50	$58,650
2020	23	5	$42.50	$58,650
2021	23	5	$42.50	$58,650

Car-share application and membership fees are not applicable to the government run fleet-sharing alternative. Therefore, these costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

10. Car Share Fees and Non-Cancellation Charges

Commercial car-sharing companies charge fees for various infractions such as not returning the vehicle on time, not ensuring at least at least half a tank of gas remains in the vehicle or leaving the vehicle dirty. These fees are important to ensure that when the next individual or command reserves a vehicle online for their use the vehicle is available, clean and ready to go, but these fees also represent a potentially significant cost to the Navy. It is impossible to perfectly predict individual behavior and therefore it is difficult to anticipate the exact amount in fees that the Navy will be charged in any given year. Based on the pilot car-sharing study conducted by GSA in Washington, DC, where participants drove 2,351 miles and accumulated $449 in car share fees and non-cancellation charges, $0.19 per mile is the factor per Table 42, that will be used to estimate potential car share fees for NAS Jacksonville (Aiken, 2016).

Table 42. Fees Accumulated During Washington, DC. Pilot. Adapted from Aiken (2016)

Fees & Non-Cancellation Charges:	$449
Total Miles Driven:	2,351
Fees Per Mile Driven:	$0.19

As previously stated, the total average annual mileage driven by vehicle-sharing-eligible automobiles is expected to remain at 350,755. At $0.19 per mile, car-sharing fees are expected to amount to $66,644. As discussed in the Quantitative Prediction segment, it is expected that as individuals adjust to the learning curve associated with the new car-sharing system the average fee per mile will decrease by 10% to $0.17. The cost associated with car-sharing fees in the years following implementation is $59,629 (see Table 43).

Table 43. Total Fees and Non-Cancellation Charges Incurred.

Year	Avg. Miles (Annual)	Avg. Fee/Mile	Total Cost Incurred (CY$)
2017	350,758	$0.19	$66,644
2018	350,758	$0.17	$59,629
2019	350,758	$0.17	$59,629
2020	350,758	$0.17	$59,629
2021	350,758	$0.17	$59,629

Car-share fees and non-cancellation charges are not applicable to the fleet-sharing alternative. Therefore, these costs will not be considered in the cost-benefit analysis between the fleet-sharing alternative and the status quo.

11. Fleet-Share Hardware Installation and Transfer Costs

A government managed fleet-sharing program requires that telematics computers be installed on all program vehicles to allow individuals access to their properly reserved vehicles and to track and transmit key metrics to program administrators such as mileage, hours and utilization. This hardware is leased from a commercial fleet-share technology provider who also installs the hardware on the government owned vehicles. Per the standard commercial pricing provided to GSA by Zipcar, the largest fleet-share technology provider in the United States, the hardware installation cost per vehicle is $150 and the hardware transfer cost is $75 (S. Ford, personal communication, October 5, 2016). All 54 vehicles will require hardware installation in the base year during implementation. In the following years (see Table 44), it is assumed that based on a five year vehicle life for cars in the fleet-sharing program, that annual vehicle turnover will be 20% of the vehicle fleet, or 10.8 vehicles which require hardware transfers. Fleet-share hardware installation and transfer costs are not applicable to the car-sharing alternative. Therefore, these costs will not be considered in the cost-benefit analysis between the car-sharing alternative and the status quo.

Table 44. Hardware Installation & Transfer Costs.

Service	Per Unit Cost	Total Units	Total Cost (2017)	Total Cost (2018)	Total Cost (2019)	Total Cost (2020)	Total Cost (2021)
Hardware Installation	$150	54	$8,100	$0.0	$0.0	$0.0	$0.0
Hardware Transfer	$75	10.8	$0	$810.0	$810.0	$810.0	$810.0
Total Hardware Costs:			**$8,100**	**$810**	**$810**	**$810**	**$810**

Adapted from S. Ford, personal communication (October 5, 2016)

12. Fleet-Share Recurring Costs

There are various recurring monthly fees associated with fleet-sharing, including the lease of the telematics units and management of the online reservation system that must be paid to the contracted fleet-sharing technology provider. Per the standard commercial pricing provided to GSA by Zipcar, the largest fleet-share technology provider in the United States, the recurring monthly costs for these services, for a vehicle fleet of 100 vehicles or less, is $85 per vehicle (S. Ford, personal communication, October 5, 2016). This equates to an annual cost of $55,080, in current year dollars (see Table 45), for the recommended 54 vehicle fleet. Fleet-sharing recurring costs are not applicable to the car-sharing alternative. Therefore, these costs will not be considered in the cost-benefit analysis between the car-sharing alternative and the status quo.

Table 45. Annual Recurring Service Costs.

Annual Recurring Service Costs				
# of Vehicles	Per Vehicle Rate	# of Vehicles	Total Cost (Monthly)	Annual Cost (CY$)
20-100	$85	54	$4,590	$55,080

13. Smart Card Costs

Smart, or RFID, cards are required to access fleet-sharing telematics equipped vehicles once a valid reservation has been processed through the online reservation system. Per the standard commercial pricing provided to GSA by Zipcar, the largest fleet-

share technology provider in the United States, the cost per RFID badge is $5.00 (S. Ford, personal communication, October 5, 2016). Assuming the previously determined figure of 9,350 military, civilian and contractor personnel requiring access to vehicles in the vehicle-sharing program the total initial cost to procure RFID smart cards in the base year (2017) is $46, 750. Assuming a moderate employee turnover rate of 5% per annum (see Table 46), the cost in follow on years to procure additional smart cards is $2,340 per year assuming the cost per card remains the same over a five year period based on the contract between the government and the fleet-sharing technology provider. Smart card costs are not applicable to the car-sharing alternative because the cost of smart cards is incorporated into the annual car-sharing membership fees.

Table 46. Smart Card Costs.

Year	Total Units	Per Unit Cost	Total Cost (CY$)
2017	9350	$5	$46,750
2018	468	$5	$2,340
2019	468	$5	$2,340
2020	468	$5	$2,340
2021	468	$5	$2,340

Tables 47 and 48 provide a summary of all of the monetized costs and benefits of the project in current year dollars. These costs will be converted to base year (2017) dollars in the next section of the CBA.

Table 47. Car-Sharing Cost and Benefit Summary.

Variables	2017	2018	2019	2020	2021	Total
Benefits:						
BSVE Program Costs Saved:	$826,521	$846,275	$866,501	$887,210	$908,414	$4,334,921
Fuel Costs Saved:	$39,676	$41,715	$43,859	$46,113	$48,484	$219,847
Additional Parking:	$53,624	$53,624	$53,624	$53,624	$53,624	$268,120
Salvage Value:	$1,379,194	$0	$0	$0	$0	$1,379,194
Costs:						
Project Managemet, Setup &	($26,091)	$0	$0	$0	$0	($26,091)
Administrative Labor Costs:	($96,718)	($97,744)	($98,780)	($99,827)	($100,885)	($493,954)
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)
Car Share Usage Costs:	($885,804)	($885,804)	($885,804)	($885,804)	($885,804)	($4,429,020)
Car Share Application Fees:	($518)	$0	$0	$0	$0	($518)
Car Share Membership Fees:	($58,650)	($58,650)	($58,650)	($58,650)	($58,650)	($293,250)
Car Share Fees & Non-Cancel	($66,644)	($59,629)	($59,629)	($59,629)	($59,629)	($305,160)
Net (CY$):	**$849,869**	**($160,213)**	**($138,879)**	**($116,963)**	**($94,446)**	**$339,368**

Table 48. Fleet-Sharing Cost and Benefit Summary.

Variables	2017	2018	2019	2020	2021	Total
Benefits:						
BSVE Program Costs Saved:	$529,712	$542,372	$555,335	$568,607	$582,197	$2,778,223
Additional Parking:	$53,624	$53,624	$53,624	$53,624	$53,624	$268,120
Salvage Value:	$750,932	$0	$0	$0	$0	$750,932
Costs:						
Project Managemet, Setup &	($26,091)	$0	$0	$0	$0	($26,091)
Administrative Management	($96,718)	($97,744)	($98,780)	($99,827)	($100,885)	($493,954)
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)
Fleet Share Hardware Installa	$8,100	$810	$810	$810	$810	$11,340
Fleetshare Recurring Costs:	($55,080)	($55,080)	($55,080)	($55,080)	($55,080)	($275,400)
Smart Card Costs:	($46,750)	($2,340)	($2,340)	($2,340)	($2,340)	($56,110)
Net (CY$):	**$803,008**	**$441,642**	**$453,569**	**$465,794**	**$478,326**	**$2,642,339**

F. DISCOUNTING TO OBTAIN PRESENT VALUE

Discounting costs and benefits to obtain present values is the next step in the CBA process (M16). Money has an opportunity cost and $100 today is worth more than $100 next year and much more than $100 in 10 years from now. This is known as the time-value of money and for this reason, all future costs and benefits in a CBA are discounted using a selected discount rate to convert all cash flows to a present value (Cellini & Kee, 2015).

According to the Office of Management and Budget (OMB) Memorandum M-16-05, the discount rate used to discount nominal cash flows in a government CBA is the nominal interest rate of treasury securities with an equivalent maturity to the CBA project life (Executive Office of the President Office of Management and Budget [OMB], 2016). Therefore, the appropriate discount rate for a government project with a five year life is 2.4% (OMB, 2016). The monetized impacts that were discounted are the BSVE program costs, fuel costs, additional parking, salvage value, project management, setup and training costs, administrative labor costs, training costs, car share usage costs, car share membership and application fees, car share fees and non-cancellation charges, fleet-share hardware installation and transfer costs, fleet-share recurring costs, and smart card costs calculated in the Impact Monetization section of this CBA and reported in current year dollars. All discounting calculations over the five year life cycle were made using Microsoft Excel and reported in fiscal year (FY) 2017 dollars.

1. Car-Share Alternative

Table 49 and Figure 6 list the discounted costs and benefits of adopting a car-sharing model at NAS Jacksonville using a nominal discount rate of 2.4%. The present value of benefits (PVB) is $5,976,117 and the present value of costs (PVC) is ($5,609,980).

Table 49. Car-Sharing Discounted Costs and Benefits by FY.

Variables	2017 (FY17$)	2018 (FY17$)	2019 (FY17$)	2020 (FY17$)	2021 (FY17$)	Total
Benefits:						
BSVE Program Costs Saved:	$826,521	$826,440	$826,360	$826,279	$826,198	$4,131,798
Fuel Costs Saved:	$39,676	$40,737	$41,827	$42,946	$44,096	$209,283
Additional Parking:	$53,624	$52,367	$51,140	$49,941	$48,771	$255,843
Salvage Value:	$1,379,194	$0	$0	$0	$0	$1,379,194
PVB:	***$2,299,015***	***$919,545***	***$919,327***	***$919,166***	***$919,064***	***$5,976,117***
Costs:						
Project Managemet, Setup & Training Costs:	($26,091)	$0	$0	$0	$0	($26,091)
Administrative Labor Costs:	($96,718)	($95,453)	($94,204)	($92,971)	($91,754)	($471,101)
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)
Car Share Usage Costs:	($885,804)	($865,043)	($844,769)	($824,969)	($805,634)	($4,226,219)
Car Share Application Fees:	($518)	$0	$0	$0	$0	($518)
Car Share Membership Fees:	($58,650)	($57,275)	($55,933)	($54,622)	($53,342)	($279,822)
Car Share Fees & Non-Cancellation Charges:	($66,644)	($58,231)	($56,867)	($55,534)	($54,232)	($291,508)
PVC:	***($1,449,146)***	***($1,076,003)***	***($1,051,772)***	***($1,028,096)***	***($1,004,963)***	***($5,609,980)***

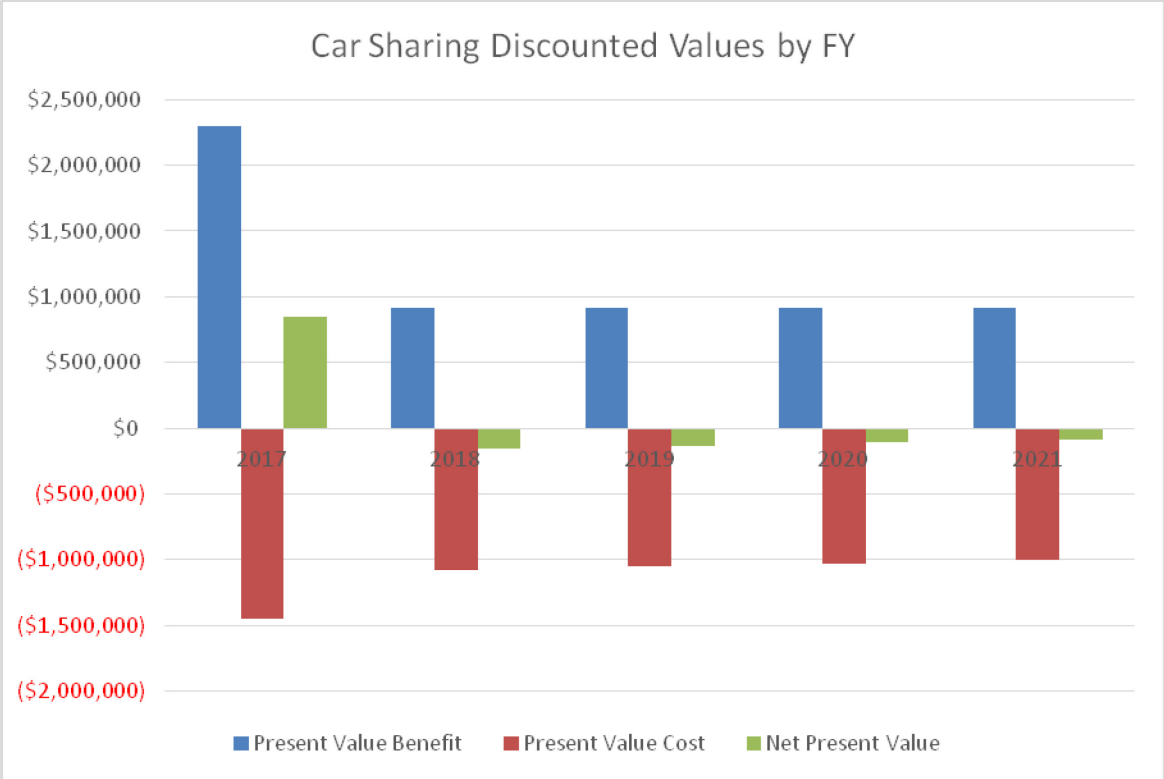

Figure 5. Car-Sharing Discounted Costs and Benefits by FY.

2. Fleet-Share Alternative

Table 50 and Figure 7 list the discounted costs and benefits of adopting a fleet-sharing model at NAS Jacksonville using a 2.4% discount rate. The present value of benefits (PVB) is $3,654,818 and the present value of costs (PVC) is ($1,119,122).

Table 50. Fleet-Sharing Discounted Costs and Benefits by FY.

Variables	2017 (FY17$)	2018 (FY17$)	2019 (FY17$)	2020 (FY17$)	2021 (FY17$)	Total
Benefits:						
BSVE Program Costs Saved:	$529,712	$529,660	$529,609	$529,557	$529,505	$2,648,043
Additional Parking:	$53,624	$52,367	$51,140	$49,941	$48,771	$255,843
Salvage Value:	$750,932	$0	$0	$0	$0	$750,932
PVB:	***$1,334,268***	***$582,027***	***$580,749***	***$579,498***	***$578,276***	***$3,654,818***
Costs:						
Project Managemet, Setup & Training Costs:	($26,091)	$0	$0	$0	$0	($26,091)
Administrative Labor Costs:	($96,718)	($95,453)	($94,204)	($92,971)	($91,754)	($471,101)
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)
Fleet Share Hardware Installation & Transfer Costs:	$8,100	$791	$772	$754	$737	$11,155
Fleetshare Recurring Costs:	($55,080)	($53,789)	($52,528)	($51,297)	($50,095)	($262,790)
Smart Card Costs:	($46,750)	($2,285)	($2,232)	($2,179)	($2,128)	($55,574)
PVC:	***($531,260)***	***($150,736)***	***($148,191)***	***($145,693)***	***($143,241)***	***($1,119,122)***

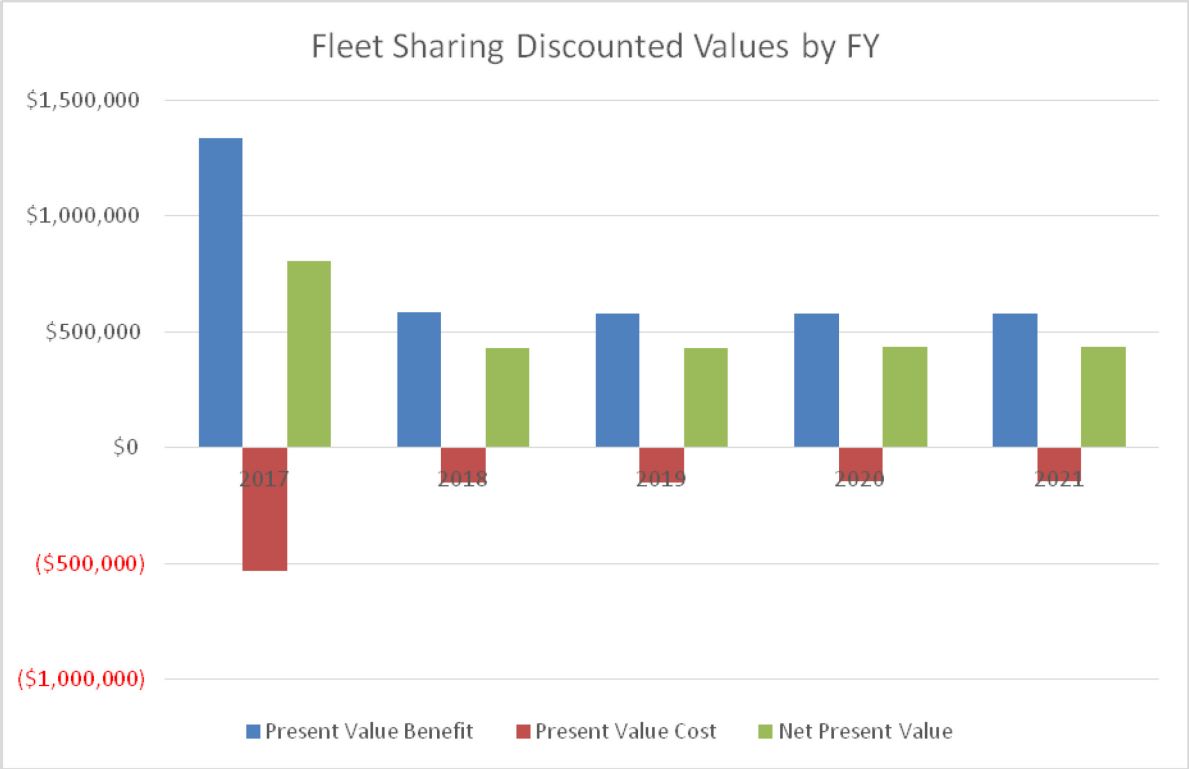

Figure 6. Fleet-Sharing Discounted Costs and Benefits by FY.

G. NET PRESENT VALUE COMPUTATION

The next step in conducting a cost-benefit analysis is to compute the Net Present Value (NPV) of the CBA, which is the figure that "can give the clearest answer to whether a project improves social welfare" (Cellini & Kee, 2015). The NPV is calculated by subtracting the Present Value of Costs (PVC) from the Present Value of Benefits (PVB).

1. Car-Sharing Alternative

Using the figures for PVC and PVB, which were previously calculated in the Present Value section of the CBA, the NPV (per Table 51) of adopting a car-sharing model at NAS Jacksonville is $366,137 (FY17 dollars) over continued operation using the Status Quo.

Table 51. Car-Sharing NPV Computation.

Variables	2017 (FY17$)	2018 (FY17$)	2019 (FY17$)	2020 (FY17$)	2021 (FY17$)	Total
Benefits:						
BSVE Program Costs Saved:	$826,521	$826,440	$826,360	$826,279	$826,198	$4,131,798
Fuel Costs Saved:	$39,676	$40,737	$41,827	$42,946	$44,096	$209,283
Additional Parking:	$53,624	$52,367	$51,140	$49,941	$48,771	$255,843
Salvage Value:	$1,379,194	$0	$0	$0	$0	$1,379,194
PVB:	***$2,299,015***	***$919,545***	***$919,327***	***$919,166***	***$919,064***	***$5,976,117***
Costs:						
Project Managemet, Setup & Training Costs:	($26,091)	$0	$0	$0	$0	($26,091)
Administrative Labor Costs:	($96,718)	($95,453)	($94,204)	($92,971)	($91,754)	($471,101)
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)
Car Share Usage Costs:	($885,804)	($865,043)	($844,769)	($824,969)	($805,634)	($4,226,219)
Car Share Application Fees:	($518)	$0	$0	$0	$0	($518)
Car Share Membership Fees:	($58,650)	($57,275)	($55,933)	($54,622)	($53,342)	($279,822)
Car Share Fees & Non-Cancellation Charges:	($66,644)	($58,231)	($56,867)	($55,534)	($54,232)	($291,508)
PVC:	***($1,449,146)***	***($1,076,003)***	***($1,051,772)***	***($1,028,096)***	***($1,004,963)***	***($5,609,980)***
NPV (FY17$):	**$849,869**	**($156,458)**	**($132,445)**	**($108,930)**	**($85,898)**	**$366,137**

The benefit to cost ratio is beneficial because it allows analysts to compare similar programs and decision makers to decide whether or not the benefit gained from the project per dollar of cost is adequate given budgetary constraints and other potential investments. The ratio is calculated by dividing the NPV of total benefits by the NPV of total costs. The NPV for the car-sharing alternative at NAS Jacksonville is 1.07 (See Table 52).

Table 52. Car-Sharing NPV Ratio

PVB:	$5,976,117
PVC:	$5,609,980
Benefit-Cost Ratio:	**1.07**

2. Fleet-Sharing Alternative

Using the figures for PVC and PVB, which were previously calculated in the Present Value section of the CBA, the NPV of adopting a fleet-sharing model at NAS Jacksonville is $2,535,696 (FY17 dollars) over continued operation using the Status Quo (See Table 53).

Table 53. Fleet-Sharing NPV Computation

Variables	2017 (FY17$)	2018 (FY17$)	2019 (FY17$)	2020 (FY17$)	2021 (FY17$)	Total
Benefits:						
BSVE Program Costs Saved:	$529,712	$529,660	$529,609	$529,557	$529,505	$2,648,043
Additional Parking:	$53,624	$52,367	$51,140	$49,941	$48,771	$255,843
Salvage Value:	$750,932	$0	$0	$0	$0	$750,932
PVB:	***$1,334,268***	***$582,027***	***$580,749***	***$579,498***	***$578,276***	***$3,654,818***
Costs:						
Project Managemet, Setup & Training Costs:	($26,091)	$0	$0	$0	$0	($26,091)
Administrative Labor Costs:	($96,718)	($95,453)	($94,204)	($92,971)	($91,754)	($471,101)
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)
Fleet Share Hardware Installation & Transfer Costs:	$8,100	$791	$772	$754	$737	$11,155
Fleetshare Recurring Costs:	($55,080)	($53,789)	($52,528)	($51,297)	($50,095)	($262,790)
Smart Card Costs:	($46,750)	($2,285)	($2,232)	($2,179)	($2,128)	($55,574)
PVC:	***($531,260)***	***($150,736)***	***($148,191)***	***($145,693)***	***($143,241)***	***($1,119,122)***
NPV (FY17$):	**$803,008**	**$431,291**	**$432,557**	**$433,804**	**$435,035**	**$2,535,696**

The NPV for the fleet-sharing alternative at NAS Jacksonville is 3.27 (see Table 54).

Table 54. Fleet-Sharing NPV Ratio

PVB:	$3,654,818
PVC:	$1,119,122
Benefit-Cost Ratio:	**3.27**

3. Summary

Figure 8 shows a charted comparison of alternative two (car-sharing) versus alternative three (fleet-sharing) over the five year analysis period. In terms of value, the fleet-sharing alternative has a clear monetary advantage, however it is important to remember that the calculations thus far are computed using estimates and assumptions. The sensitivity analysis is the next logical step to see how sound the estimates and assumptions are.

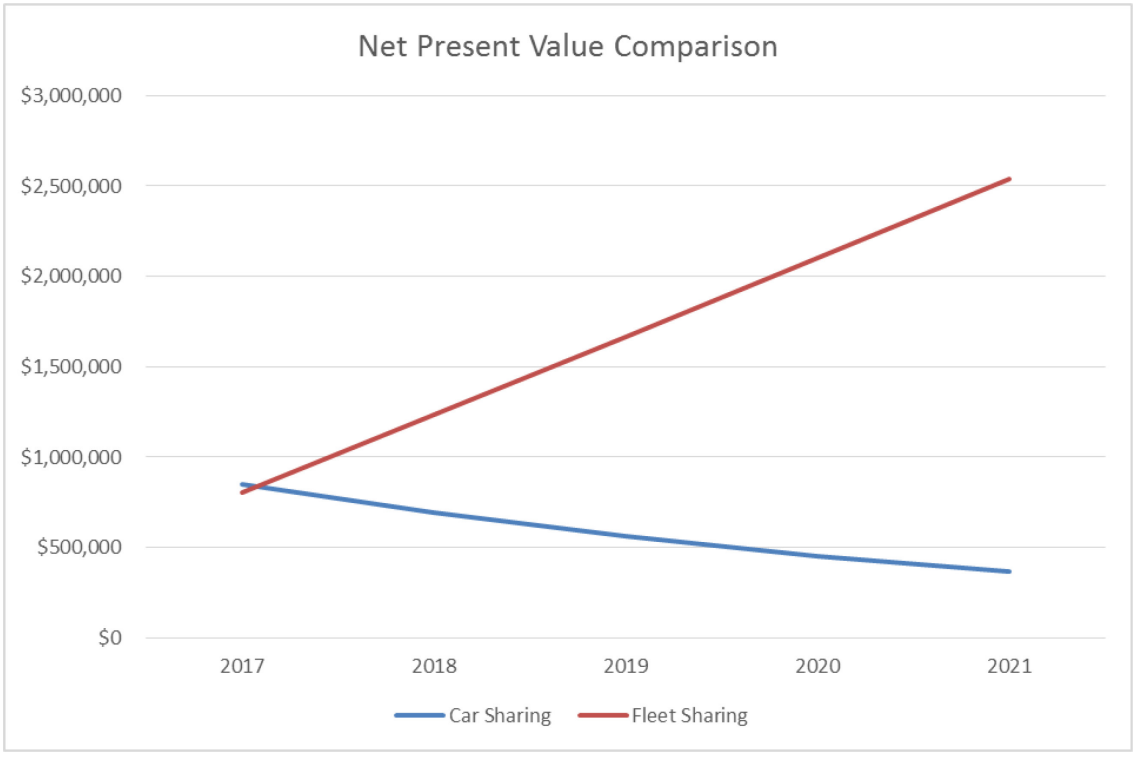

Figure 7. Net Present Value Comparison

H. SENSITIVITY ANALYSIS

In conducting an analysis and providing a recommended course of action to Naval Facilities Engineering Command (NAVFAC), this project is reliant on certain assumptions due to a deficiency of real time data that would have been provided by installed telematics technology. As the uncertainty surrounding the various assumptions increases, the sensitivity analysis becomes increasingly critical in the conduct of a cost-benefit analysis. Acknowledging the uncertainty of the overall net benefit by performing a sensitivity analysis will help to show how dynamic the net benefits are, based on changes in the assumptions. The more dynamic the changes to the net benefits, the less confidence can be placed on the results, the more static the net benefits, the more confidence can be had in the results.

1. Methodology

For conducting the CBA Sensitivity Analysis, there are three options: A "Partial Sensitivity Analysis," a "Worst- and Best-Case Analysis," and a "Monte Carlo Analysis." (Boardman et al., 2011, pp. 177–187) A Partial Sensitivity Analysis relies on changing one variable at a time while holding all other variables constant. The Worst- and Best-Case, or Extreme Case, Sensitivity Analysis "varies all of the uncertain parameters simultaneously" to yield a best or worst-case scenario (Cellini & Kee, 2015). The Monte Carlo Analysis uses probability distributions of net benefits to provide a risk assessment of the data variance. Although the Monte Carlo Analysis is the most sophisticated and exhaustive, it is also the most time and resource intensive and for this reason "partial and extreme case sensitivity analyses remain the methods of choice for most analysts" (Cellini & Kee, 2015). The large number of critical assumptions in this CBA limits the effectiveness of a Partial Sensitivity Analysis, making Extreme Case Sensitivity Analysis the best alternative for conducting sensitivity analysis of the costs and benefits associated with adopting a vehicle-sharing model at NAS Jacksonville. Although the commonality of multiple variables occurring at the extremes at the same time is not anticipated, this type of analysis remains the best option for evaluating sensitivity given the level of relative uncertainty surrounding many of the variables. Additionally, since both

alternatives provide an initial positive net benefit, only the worst-case will be evaluated to determine if a negative outcome can be reached. According to Cellini et al., "if a project looks good even under the worst-case assumption, it strengthens the case to go forward" (Cellini & Kee, 2015).

2. Car-Sharing Sensitivity Analysis

a. Identify Base-Case Values Used for Primary Assumptions

For all net benefit assumptions used for the car-sharing calculation, the assumptions with primary importance must first be defined and each variable graded based on the assessed level of uncertainty (see Table 55).

Table 55. Car-Sharing Base-Case Values and Level of Uncertainty.

Variables	2017	2018	2019	2020	2021	Total	Level of Uncertainty
Benefits:	**(FY17$)**	**(FY17$)**	**(FY17$)**	**(FY17$)**	**(FY17$)**	**(FY17$)**	
BSVE Program Costs Saved:	$826,521	$826,440	$826,360	$826,279	$826,198	$4,131,798	High
Fuel Costs Saved:	$39,676	$40,737	$41,827	$42,946	$44,096	$209,283	High
Additional Parking:	$53,624	$52,367	$51,140	$49,941	$48,771	$255,843	Moderate
Salvage Value:	$1,379,194	$0	$0	$0	$0	$1,379,194	Low
Costs:							
Project Managemet, Setup & Training Costs:	($26,091)	$0	$0	$0	$0	($26,091)	Moderate
Administrative Labor Costs:	($96,718)	($95,453)	($94,204)	($92,971)	($91,754)	($471,101)	Moderate
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)	Low
Car Share Usage Costs:	($885,804)	($865,043)	($844,769)	($824,969)	($805,634)	($4,226,219)	High
Car Share Application Fees:	($518)	$0	$0	$0	$0	($518)	Low
Car Share Membership Fees:	($58,650)	($57,275)	($55,933)	($54,622)	($53,342)	($279,822)	High
Car Share Fees & Non-Cancellation Charges:	($66,644)	($58,231)	($56,867)	($55,534)	($54,232)	($291,508)	Moderate
Net (FY17$):	**$849,869**	**($156,458)**	**($132,445)**	**($108,930)**	**($85,898)**	**$366,137**	

b. Worst-Case Value Assignment

Next, parameters will be assigned from Table 55 with a determined degree of uncertainty a worst-case value (see Table 56).

Table 56. Estimated Worst-Case Values.

Variables	2017 (FY17$)	2018 (FY17$)	2019 (FY17$)	2020 (FY17$)	2021 (FY17$)	Total (FY17$)
Benefits:						
BSVE Program Costs Saved:	$807,228	$783,717	$760,890	$738,728	$717,212	$3,807,774
Fuel Costs Saved:	$37,736	$36,637	$35,570	$34,534	$33,528	$178,004
Additional Parking:	$48,262	$46,856	$45,492	$44,167	$42,880	$227,657
Salvage Value:	$1,216,936	$0	$0	$0	$0	$1,216,936
Costs:						
Project Managemet, Setup & Training Costs:	($39,136)	($946,005)	($918,451)	($891,700)	($865,728)	($3,661,021)
Administrative Labor Costs:	($97,140)	$0	$0	$0	$0	($97,140)
Training Costs:	($377,665)	$0	$0	$0	$0	($377,665)
Car Share Usage Costs:	($974,385)	($93,786)	($91,055)	($88,403)	($85,828)	($1,333,457)
Car Share Application Fees:	($575)	$0	$0	$0	$0	($575)
Car Share Membership Fees:	($96,600)	($64,703)	($62,818)	($60,989)	($59,212)	($344,322)
Car Share Fees & Non-Cancellation Charges:	($66,644)	($95,725)	($94,331)	($92,957)	($91,603)	($441,261)
Net (FY17$):	**$458,017**	**($333,010)**	**($324,704)**	**($316,621)**	**($308,752)**	**($825,070)**

The worst-case values were adjusted based the following modifications:

- BSVE Program Costs Saved: For the original analysis, it was assumed that BSVE rates would continue to grow at a rate of 2.39% per year, which has been the historical growth rate over the last five years based on NAVFAC provided data (E. Walter, personal communication, 11 October, 2016). As the data shows, rates can be highly volatile with large increases or decreases for some years and no then no changes for several years in a row. For the sensitivity analysis, it was assumed that there would be no growth and that rates would remain constant at fiscal year 2016 levels (see Table 57). This has a negative impact on the future benefit of reducing the number of government owned and operated vehicles in the motor vehicle fleet.

Table 57. BSVE Static Rate Assumption.

Vehicle Category	2017 (CY$)	2018 (CY$)	2019 (CY$)	2020 (CY$)	2021 (CY$)
Truck, Pickup Compact 4x2	$100,776	$100,776	$100,776	$100,776	$100,776
Truck, Pickup 4x2, Crew Cab	$251,904	$251,904	$251,904	$251,904	$251,904
Truck, 1/2T Pickup 4x2	$46,032	$46,032	$46,032	$46,032	$46,032
Truck, Sport Utility, Commercial, 4x2	$16,920	$16,920	$16,920	$16,920	$16,920
Truck, Van, 7 Pass, Compact	$146,880	$146,880	$146,880	$146,880	$146,880
Truck, Van, 8 Pass	$31,980	$31,980	$31,980	$31,980	$31,980
Truck, Van, 12 Pass	$79,056	$79,056	$79,056	$79,056	$79,056
Truck, Van, 15 Pass	$81,504	$81,504	$81,504	$81,504	$81,504
Sedan, Sub Compact	$8,112	$8,112	$8,112	$8,112	$8,112
Sedan, Compact	$44,064	$44,064	$44,064	$44,064	$44,064
Total (CY$):	**$807,228**	**$807,228**	**$807,228**	**$807,228**	**$807,228**

- Fuel Costs Saved: For the original analysis, it was assumed that fuel costs would grow at an annual rate of 5.14%, which is the annual growth rate for fuel costs over the last 20 years. For the sensitivity analysis, it was assumed that fuel prices would remain constant (see Table 58) at the historical low 2016 level of $1.78 per gallon ("Gas prices by state," 2016). This has a negative impact on the future benefit associated with fuel costs when adopting a car-sharing model, in which the fuel costs are incorporated into the contractually set hourly car-sharing rates.

Table 58. Worst-Case Estimated Fuel Costs per Calendar Year.

Year	Gallons	P/gal	Total Cost (CY$)
2017	21,200	1.78	$37,736
2018	21,200	1.78	$37,736
2019	21,200	1.78	$37,736
2020	21,200	1.78	$37,736
2021	21,200	1.78	$37,736

- Additional Parking: For the original analysis, it was assumed that consumer's willingness to pay (WTP) for parking in the Jacksonville area was equivalent to the average rate for city managed parking facilities in Jacksonville, which is $66.70 per

month or $800.36 per year ("Jacksonville CITY-MANAGED DOWNTOWN PUBLIC PARKING FACILITIES," 2016). For the sensitivity analysis, it was assumed that consumer's WTP was actually 10% lower than previously assumed see Table 59).

Table 59. Worst-Case Estimated Parking Costs base on WTP

Year	Additional Parking Spots	WTP (Annual)	Total Benefit (CY$)
2017	67	$720.32	$48,262
2018	67	$720.32	$48,262
2019	67	$720.32	$48,262
2020	67	$720.32	$48,262
2021	67	$720.32	$48,262

- Salvage Value: For the original analysis, it was assumed that NAVFAC would be able to dispose of all excess vehicles on the open market at a value 15% below the market value reported by Kelley Blue Book (KBB). For the sensitivity analysis, it was assumed all excess vehicles were sold at 25% below the market rate reported by KBB (see Table 60).

Table 60. Worst-Case Vehicle Salvage Values.

Vehicle Category	Avg Per Vehicle Salvage Value	Vehicle Reduction	Salvage Value (Market)	Salvage Value (Market-25%)
Truck, Pickup Compact 4x2	$10,484	17	$178,228	$133,671.00
Truck, Pickup 4x2, Crew Cab	$14,563	32	$466,016	$349,512.00
Truck, 1/2T Pickup 4x2	$10,290	7	$72,030	$54,022.50
Truck, Sport Utility, Commercial, 4x2	$9,384	2	$18,768	$14,076.00
Truck, Van, 7 Pass, Compact	$12,032	24	$288,768	$216,576.00
Truck, Van, 8 Pass	$14,895	5	$74,475	$55,856.25
Truck, Van, 12 Pass	$19,819	12	$237,828	$178,371.00
Truck, Van, 15 Pass	$17,096	12	$205,152	$153,864.00
Sedan, Sub Compact	$8,146	2	$16,292	$12,219.00
Sedan, Compact	$8,128	8	$65,024	$48,768.00
Total (FY17$):		**121**	**$1,622,581**	**$1,216,936**

- Project Management, Setup & Training Administration Costs: For the original analysis, project management, setup and training costs were assumed to be $26,091 based on historical data from the pilot studies in Norfolk, Great Lakes and Bangor conducted in 2013 (Cook et al., 2013) and adjusted for inflation. For the sensitivity analysis, it was assumed that these costs would be 10% higher than previously anticipated or $39,136 in FY17$.

- Administrative Labor Costs: For the original analysis, administrative labor costs were assumed to grow at 1.06% per year based on historical growth rates observed over the last four years ("Florida General Schedule (GS) Pay Scale for 2016," n.d.). For the sensitivity analysis, labor costs were assumed to grow at 1.5% per annum, which increases total labor costs over the project life (see Table 61).

Table 61. Worst-Case Labor Wage Growth Estimate.

Year	2017	2018	2019	2020	2021
Salary (CY$)	$97,140	$98,597	$100,076	$101,577	$103,100
% Change		1.50%	1.50%	1.50%	1.50%

- Training Opportunity Costs: The original analysis training costs were estimated based on a 50% participation rate in the vehicle-sharing program across all employees at NAS Jacksonville. For the sensitivity analysis, the participation rate was increased to 60%, which increases the opportunity costs to the Navy resulting from the additional employee hours lost to training (see Table 62).

Table 62. Worst-Case Enrollment Costs.

Initial Employee Enrollment	
Employee Category	**Enrollment**
DoD Employees	10,200
Federal Employees	6,000
Contract Employees	2,500
Total Employees	18,700
% of Employees Enrolled in Program	60%
Estimate of Initial Enrollment:	**11,220**
Total Cost at $33.66 per Employee Hour:	**$377,665**

- Car Share Usage Costs: For the original analysis, car share usage costs were predicted by first converting annual mileage to hours using the ratio experienced during the vehicle-sharing pilot at NAVSTA San Diego (Serafino, 2011) and then estimating hourly car-sharing rates by developing a ratio between existing car-sharing rates and the MSRP of those vehicles and applying this ratio to the MSRP of typical government vehicles. For the sensitivity analysis, it was assumed that these costs would be 10% higher than previously anticipated (see Table 63).

Table 63. Worst-Case Car Share Usage Costs.

Vehicle Category	Average Miles (Annual)	Average Hours/Mile	Total Hours (Annual)	Carsharing Charge (Hourly)	Carsharing Costs (Annual)
Truck, Pickup Compact 4x2	41,574	0.14	5,820	$14.46	$96,786
Truck, Pickup 4x2, Crew Cab	68,448	0.14	9,583	$19.13	$210,783
Truck, 1/2T Pickup 4x2	13,069	0.14	1,830	$15.91	$33,478
Truck, Sport Utility, Commercial, 4x2	5,437	0.14	761	$14.15	$12,385
Truck, Van, 7 Pass, Compact	71,587	0.14	10,022	$14.15	$163,031
Truck, Van, 8 Pass	31,897	0.14	4,466	$18.95	$97,317
Truck, Van, 12 Pass	41,267	0.14	5,777	$20.37	$135,365
Truck, Van, 15 Pass	46,497	0.14	6,510	$21.75	$162,820
Sedan, Sub Compact	5,605	0.14	785	$10.33	$9,319
Sedan, Compact	25,377	0.14	3,553	$13.00	$53,102
Total (CY$):					**$974,385**

- Car Share Application Fees: For the original analysis, car share application fees were calculated by averaging the application fees charged by the two largest car-sharing providers in the United States, Zipcar and Enterprise Car Share. For the sensitivity analysis, it was assumed that application fee charged per command utilizing the program would be the higher of the two application fees rather than the average, which is the $25 charged by Zipcar ("Atlanta car-sharing rates & plans," n.d.) (see Table 64).

Table 64. Worst-Case Car Share Application Fees.

Year	# of Commands	One-time Application Fee	Total Cost (FY17$)
2017	23	$25.00	$575

- Car Share Membership Fees: For the original analysis, monthly membership fees were estimated based on the average of the fees charges by the two largest car-sharing providers in the United States, Zipcar and Enterprise Car Share, and assuming that each command enrolled in the program would on average require five memberships to be shared among the employees. For the sensitivity analysis, it was assumed that the monthly membership fee charged would be the higher of the two application fees rather than the average, which is the $50 charged by Zipcar ("Atlanta car-sharing rates & plans," n.d.), and each command enrolled in the program would require an average of seven memberships (see Table 65).

Table 65. Worst-Case Car Share Membership Fees.

Year	# of Commands:	Memberships per Command	Membership Fee (Monthly)	Annual Cost (CY$)
2017	23	7	$50.00	$96,600
2018	23	7	$50.00	$96,600
2019	23	7	$50.00	$96,600
2020	23	7	$50.00	$96,600
2021	23	7	$50.00	$96,600

- Car Share Fees & Non-Cancellation Charges: For the original analysis, it was assumed that penalty fees and non-cancellation charges would decrease 10% after the first year as employees mastered the learning curve associated with the new program. For the sensitivity analysis, it was assumed that penalty fees and non-cancellation charges would remain constant across the five year project life, which increases the total costs associated with the program (see Table 66).

Table 66. Worst-Case Fees and Non-Cancellation Charges.

Year	Avg. Miles (Annual)	Avg. Fee/Mile	Total Cost Incurred (CY$)
2017	350,758	$0.19	$66,644
2018	350,758	$0.19	$66,644
2019	350,758	$0.19	$66,644
2020	350,758	$0.19	$66,644
2021	350,758	$0.19	$66,644

- Discount Rate: For the original analysis, a discount rate of 2.4% was chosen which is consistent with current interest rates on five year Treasury securities (OMB, 2016). The sensitivity analysis assumed an increase in interest rates and all current year calculations in this section were then adjusted to present values using a discount rate of 3%.

c. Base-Case Versus Worst-Case Net Benefit Comparison

The downward trend in net benefits is quite apparent in Figure 8 and although the estimated project length is only five years due to the rapid advancement in technology and vehicle-sharing options, the car-sharing losses are only offset by the initial jump in value due to the salvage sale of the existing fleet. The Worst-Case values flip the sign and add a significant level of risk to an already mediocre five year cumulative value.

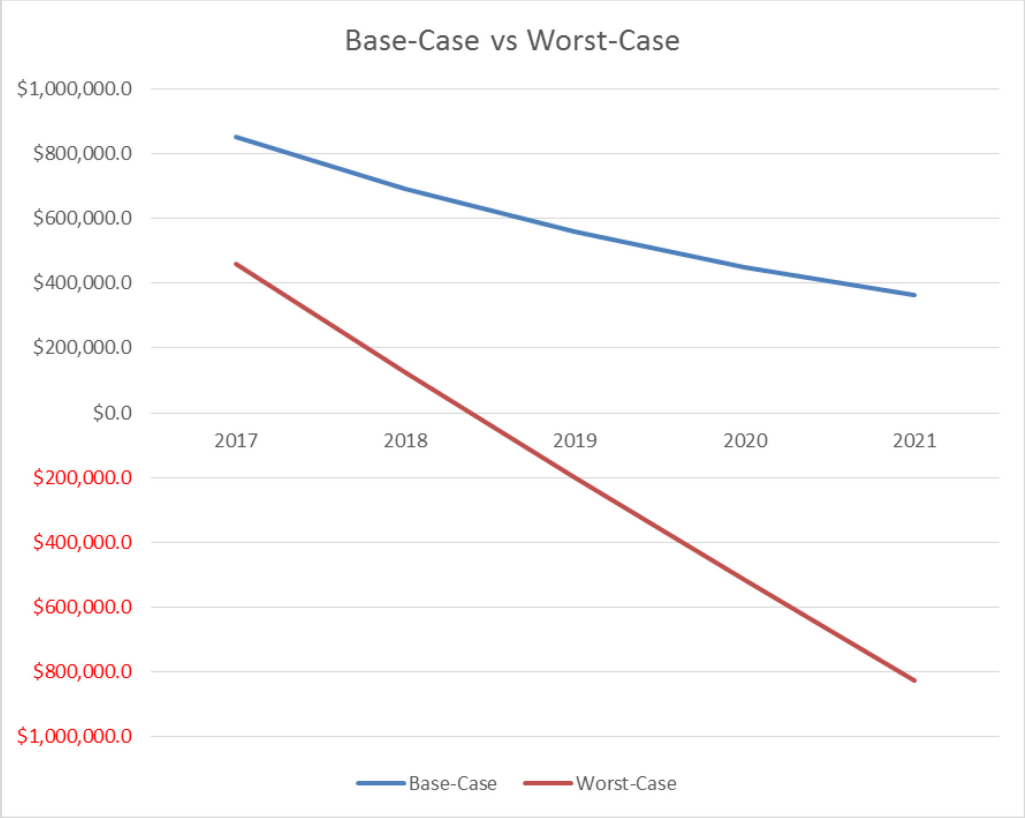

Figure 8. 5-Year Net Benefits of Worst-Case Values.

3. Sensitivity Analysis for Fleet-Sharing Alternative

a. Identify Base-Case Values Used for Primary Assumptions

For all net benefit assumptions used in this project, the assumptions with primary importance must first be defined and each variable graded based on the assessed level of uncertainty. Table 67 lists all the variables and the assessed level of uncertainty.

Table 67. Five Year Base-Case Values and Uncertainty Levels.

Variables	2017	2018	2019	2020	2021	Total	Level of Uncertainty
	(FY17$)	(FY17$)	(FY17$)	(FY17$)	(FY17$)	(FY17$)	
Benefits:							
BSVE Program Costs Saved:	$529,712	$529,660	$529,609	$529,557	$529,505	$2,648,043	High
Additional Parking:	$53,624	$52,367	$51,140	$49,941	$48,771	$255,843	Moderate
Salvage Value:	$750,932	$0	$0	$0	$0	$750,932	Low
Costs:							
Project Managemet, Setup & Training Costs:	($26,091)	$0	$0	$0	$0	($26,091)	Moderate
Administrative Labor Costs:	($96,718)	($95,453)	($94,204)	($92,971)	($91,754)	($471,101)	Moderate
Training Costs:	($314,721)	$0	$0	$0	$0	($314,721)	Low
Fleet Share Hardware Installation & Transfer Costs:	$8,100	$791	$772	$754	$737	$11,155	Low
Fleetshare Recurring Costs:	($55,080)	($53,789)	($52,528)	($51,297)	($50,095)	($262,790)	Low
Smart Card Costs:	($46,750)	($2,285)	($2,232)	($2,179)	($2,128)	($55,574)	Low
Net (FY17$):	**$803,008**	**$431,291**	**$432,557**	**$433,804**	**$435,035**	**$2,535,696**	

b. Worst-Case Value Assignment

Next, a worst-case value will be assigned to all calculated parameters from Table 67 that have a determined degree of uncertainty (see Table 68).

Table 68. Fleet-Sharing Worst-Case Values.

Variables	2017 (FY17$)	2018 (FY17$)	2019 (FY17$)	2020 (FY17$)	2021 (FY17$)	Total (FY17$)
Benefits:						
BSVE Program Costs Saved:	$450,996	$437,860	$425,107	$412,725	$400,704	$2,127,393
Additional Parking:	$48,262	$46,856	$45,492	$44,167	$42,880	$227,657
Salvage Value:	$662,587	$0	$0	$0	$0	$662,587
		$0	$0	$0	$0	$0
Costs:		$0	$0	$0	$0	$0
Project Managemet, Setup & Training Costs:	($39,136)	$0	$0	$0	$0	($39,136)
Administrative Labor Costs:	($97,140)	($95,725)	($94,331)	($92,957)	($91,603)	($471,757)
Training Costs:	($377,665)	$0	$0	$0	$0	($377,665)
Fleet Share Hardware Installation & Transfer Costs:	($10,125)	($983)	($955)	($927)	($900)	($13,890)
Fleetshare Recurring Costs:	($68,850)	($66,845)	($64,898)	($63,008)	($61,172)	($324,772)
Smart Card Costs:	($56,100)	($5,447)	($5,288)	($5,134)	($4,984)	($76,953)
Net (FY17$):	**$512,829**	**$315,717**	**$305,127**	**$294,866**	**$284,924**	**$1,713,463**

- BSVR Program Costs Saved: For the original analysis, it was assumed that BSVE rates would continue to grow at 2.39% per year, which has been the historical growth rate over the last five years (E. Walter, personal communication, 11 October, 2016). As the data shows in Table 69, rates can be highly volatile with large increases or decreases for some years and then no changes for several years in a row. For the sensitivity analysis, it was assumed that there would be no growth and that rates would remain constant at fiscal year 2016 levels. This has a negative impact on the future benefit of reducing the number of government owned and operated vehicles in the motor vehicle fleet.

Table 69. Worst-Case BSVR Program Costs Saved.

Vehicle Category	2017 (CY$)	2018 (CY$)	2019 (CY$)	2020 (CY$)	2021 (CY$)
Truck, Pickup Compact 4x2	$65,208	$65,208	$65,208	$65,208	$65,208
Truck, Pickup 4x2, Crew Cab	$165,312	$165,312	$165,312	$165,312	$165,312
Truck, 1/2T Pickup 4x2	$32,880	$32,880	$32,880	$32,880	$32,880
Truck, Sport Utility, Commercial, 4x2	$8,460	$8,460	$8,460	$8,460	$8,460
Truck, Van, 7 Pass, Compact	$79,560	$79,560	$79,560	$79,560	$79,560
Truck, Van, 8 Pass	$0	$0	$0	$0	$0
Truck, Van, 12 Pass	$39,528	$39,528	$39,528	$39,528	$39,528
Truck, Van, 15 Pass	$33,960	$33,960	$33,960	$33,960	$33,960
Sedan, Sub Compact	$4,056	$4,056	$4,056	$4,056	$4,056
Sedan, Compact	$22,032	$22,032	$22,032	$22,032	$22,032
Total (CY$):	**$450,996**	**$450,996**	**$450,996**	**$450,996**	**$450,996**

- Additional Parking: Rationale is the same as for the car-sharing alternative.
- Salvage Value: For the original analysis, it was assumed that NAVFAC would be able to dispose of all excess vehicles on the open market at a value 15% below the market value reported by Kelley Blue Book (KBB). For the sensitivity analysis, it was assumed in Table 70, all excess vehicles were sold at 25% below the market rate reported by KBB.

Table 70. Worst-Case Salvage Value.

Vehicle Category	Avg Per Vehicle Salvage Value	Vehicle Reduction	Salvage Value (Market)	Salvage Value (25% Below Market)
Truck, Pickup Compact 4x2	$10,484	11	$115,324	$86,493.00
Truck, Pickup 4x2, Crew Cab	$14,563	21	$305,823	$229,367.25
Truck, 1/2T Pickup 4x2	$10,290	5	$51,450	$38,587.50
Truck, Sport Utility, Commercial, 4x2	$9,384	1	$9,384	$7,038.00
Truck, Van, 7 Pass, Compact	$12,032	13	$156,416	$117,312.00
Truck, Van, 8 Pass	$14,895	0	$0	$0.00
Truck, Van, 12 Pass	$19,819	6	$118,914	$89,185.50
Truck, Van, 15 Pass	$17,096	5	$85,480	$64,110.00
Sedan, Sub Compact	$8,146	1	$8,146	$6,109.50
Sedan, Compact	$8,128	4	$32,512	$24,384.00
Total (FY17$):		**67**	**$883,449**	**$662,587**

- Project Management, Setup & Training Administration Costs: Rationale is the same as for the car-sharing alternative.
- Administrative Labor Costs: Rationale is the same as for the car-sharing alternative.
- Training Opportunity Costs: Rationale is the same as for the car-sharing alternative.
- Fleet-Share Hardware Installation & Transfer Costs: For the original analysis, hardware costs were determined based on commercial pricing provided by Zipcar. For the sensitivity analysis, it was assumed that costs would be 25% higher than previously expected (see Table 71).

Table 71. Worst-Case Fleet-Share Hardware Installation and Transfer Costs.

Service	Per Unit Cost	Total Units	Total Cost (2017)	Total Cost (2018)	Total Cost (2019)	Total Cost (2020)	Total Cost (2021)
Hardware Installation	$188	54	$10,125	$0.0	$0.0	$0.0	$0.0
Hardware Transfer	$94	10.8	$0	$810.0	$810.0	$810.0	$810.0
Total Hardware Costs (CY$):			**$10,125**	**$810**	**$810**	**$810**	**$810**

- Fleet-Share Recurring Costs: For the original analysis, recurring costs were determined based on commercial pricing provided by Zipcar. For the sensitivity analysis, it was assumed that costs would be 25% higher than previously expected (see Table 72).

Table 72. Worst-Case Fleet-Share Recurring Costs.

	Per Vehicle Rate	# of Vehicles	Total Cost (Monthly)	Annual Cost (CY$)
20-100	$106	54	$5,738	$68,850

- Smart Card Costs: For the original analysis, it was assumed that employee turnover would be five % per year. For the sensitivity analysis, a 10% annual employee turnover was assumed (see Table 73).

Table 73. Worst-Case Smart Card Costs.

Year	Total Units	Per Unit Cost	Total Cost (CY$)
2017	11220	$5	$56,100
2018	1,122	$5	$5,610
2019	1,122	$5	$5,610
2020	1,122	$5	$5,610
2021	1,122	$5	$5,610

c. Worst-Case Analysis

The comparison (figure 9) of the $2.5M net benefit of the base-case to a lesser $1.8M net benefit in the worst-case scenario lends a strong visual representation to the data set although the gap widens over time, the steady upward trend at the completion of the five year analysis with both the base-case and the worst-case offers a promising option over the status quo.

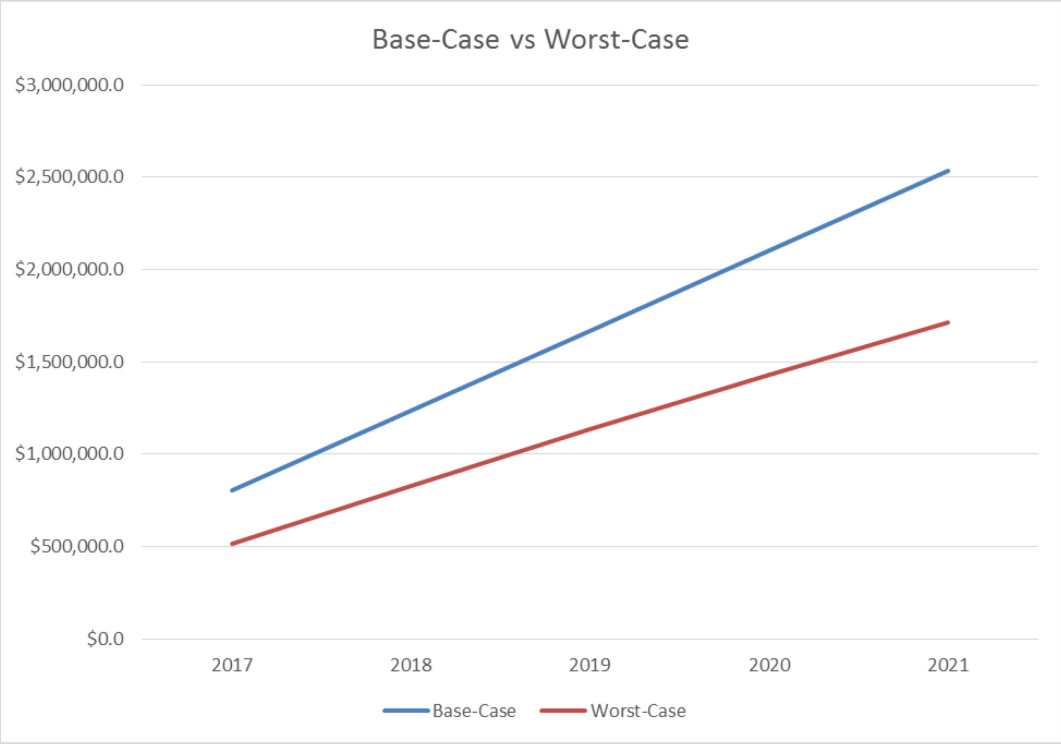

Figure 9. 5-Year Net Benefits of Worst-Case Values

4. Summary

The Sensitivity Analysis was successful in flipping the sign of the car-sharing model to a negative NPV, which significantly weakens the case to adopt car-sharing over the status quo. The fleet-sharing alternative remained strong even with the worst-case variables, which indicates a strong model for recommendation.

V. RECOMMENDATION AND FUTURE RESEARCH

A. CONCLUSIONS

The goal of a cost-benefit analysis (CBA) is to provide a rational recommendation for decision making based on a net benefit analysis of all selected stakeholders. Ideally, a global view is preferred for a CBA to understand the impact to everyone, however that depth of detail is outside the preferred scope of this project so a national perspective was selected. The goal of this CBA is to answer the following questions with a comprehensive support structure.

1. Could implementation or integration of a commercial car-sharing model or software be financially beneficial to the Navy? If so, how?

Based on the 5-year calculations both models prove to be beneficial from a financial standpoint. However, the car-sharing model is only beneficial using the five year model due to the initial benefit received from the sale of the excess government vehicles. Over time, however, the costs of car-sharing to the government exceed the benefits and the model becomes more expensive than the Status Quo. This indicates a significant risk associated with adopting a car-sharing model. The sensitivity analysis also revealed significant risk associated with adopting a car share model. When the parameters were flexed and a worst-case scenario was adopted the net present value (NPV) of the car share model was significantly negative which represents a loss of value to the Navy. Given the large degree of uncertainty associated with many of the variables analyzed there is a high degree of risk associated with the adoption of car-sharing at NAS Jacksonville.

The NPV of the fleet-sharing model on the other hand is positive, and to a greater degree, in both the long run (end of the analyzed five year period) as well as the short run (one year into the study). The sensitivity analysis revealed there is also less risk associated with adopting a fleet-sharing model then a car-sharing model. When parameters were flexed and the worst-case scenario adopted the NPV for fleet-sharing was still positive. Expanding the fleet-sharing model to other larger Naval installations will increase the costs savings and provide a significant net benefit to all shareholders.

2. Can vehicle utilization be increased, while reducing fleet size using available alternatives? If so, by how much?

The prior pilot studies proved the concept of increasing vehicle utilization by decreasing quantities of available vehicles while maintaining acceptable levels of customer satisfaction, though the long-term costs and benefits of doing so were not explicitly studied or calculated. Reducing the fleet size without changing the demand elicits an increase in vehicle utilization from 22% to 45%. The challenge of the CBA is to identify which method is more beneficial to use while providing the same or better opportunity for end user access to mission specific vehicles.

3. What are additional pros and cons of the available alternatives, and what are the specific challenges from the Navy perspective?

The unknowns and the uncertainty of several key variables are the biggest concerns. Implementing hardware that stores and transmits user data into a government owned vehicle carries force protection and safety concerns as does the data retention service and the feasibility of allowing a non-government entity manage the data. The DOD Instruction 8510.01 "Risk Management (RMF) Framework for DOD Information Technology (IT)" (DOD, 2014) requires that all "DOD IT that receive, process, store, display, or transmit DOD information" must have an Authorizing Official (AO) and is required to undergo a cyber security review to identify and address vulnerabilities prior to implementation (DOD, 2014). The cost associated with the cyber security review and approval process was impossible to ascertain and thus not included within the scope of this CBA. The review in question is for the hardware and technology, which is not solely applicable to NAS Jacksonville. It is estimated that the man hours associated with conducting the cyber security review of the fleet-sharing hardware and software systems may cost in excess of a million dollars, which would be a one-time cost absorbed by NAVFAC if they choose to implement fleet-sharing technology.

B. RECOMMENDATION

Based on a combination of Net Present Value and the sensitivity analysis, we recommend alternative three, the adoption of the fleet-sharing alternative at NAS Jacksonville, however, the unknown cost of the cyber security review could offset the

positive benefit of implementing a fleet-sharing model at NAS Jacksonville if the total cost of the cyber security review was assigned solely to the NAS Jacksonville vehicle-sharing project. Because GSA already telematics options available, we assume the research is a shared cost among multiple vehicle-sharing projects across the government enterprise and not associated solely with NAS Jacksonville. If this assumption holds true, implementing fleet-sharing technology to a NAVFAC managed government owned fleet will result in both short-term and long-term cost savings with significantly less risk than commercial car-sharing. There are also extensive opportunities for program expansion beyond NAS Jacksonville with significant economies of scale as the program spreads to additional installations.

C. OPPORTUNITIES FOR FUTURE RESEARCH

1. CBA Increased Scope to Include Costs and Benefits at the DOD or National Level

S*tanding* was used at the Federal Government level restricted to the JAX NAS local, however a wider scope would impact results if the CBA were implemented on a *big navy* perspective.

2. Evaluate the Impact of the Manning Requirements due to Changes in the Vehicle Management.

The short-term (5-Year) assessment in this CBA cannot adequately project the impact to the manning over a long-term change. Contracting a commercial car-sharing provider across all Navy installations would have a significant impact on the long-term employment of NAVFAC mechanics, administrative personnel, and even military support staff.

3. Perform a Monte Carlo Analysis

Due to limitations in both available time and resources, the sensitivity analysis was conducted using a worst-case approach. A full Monte Carlo Analysis in which all of the variables are changed incrementally and the simulation is then run thousands of times

could give analysts a more precise understanding of the risk associated with adopting each vehicle-sharing model.

4. Cost of Adding Common Access Cards (CAC) RFID capability

Currently the General Services Administration (GSA) is studying the feasibility of adopting RFID technology to the CAC cards already carried by all government personnel. This would eliminate the requirement for personnel to carry an additional dedicated RFID card to access government vehicles equipped with fleet-sharing technology. This convenience factor has the potential to increase the benefits associated with the fleet-sharing alternative. The costs associated with RFID CAC cards are unknown at this time.

5. Daily and Hourly Rates for Car-Sharing

All calculations for costs associated with the car-sharing model were made assuming only hourly rates were available. In the commercial car-share market many vendors offer daily rates in addition to hourly rates for customers that require the use of a vehicle for longer periods of time. Enterprise Car Share, for example, offers an hourly rate of $8.50 for a sub-compact car and a daily rate of $70.00 for the same vehicle. If the vehicle is needed for more than 8.24 hours, it becomes more economical to utilize the daily rate. A daily rate may be convenient for some commands whose personnel utilize the vehicle for overnight or multi-day trips and the adoption of a daily rate into the car-sharing contract in addition to the hourly rate may impact the NPV associated with the car-sharing alternative.

6. Disaggregate Base Support, Vehicle and Equipment (BSVE) Costs

As previously described, the majority of cost savings associated with adopting a vehicle-sharing alternative come from the reduction in annual BSVE payments made by tenant commands to NAVFAC for the long-term use of government vehicles. The BSVE is designed as a break-even rate for reimbursable costs associated with maintaining the NAVFAC vehicle program, including direct labor costs, direct costs other than labor and indirect, or overhead costs. Although this was the best metric available for estimating the

costs savings associated with vehicle sharing it is unclear just how accurately this metric reflects the true costs savings associated with reducing total number of government owned vehicles in Jacksonville. If the BSVE could be disaggregated and a true cost could be assigned to vehicle procurement, maintenance, depreciation, program administration, personnel and facilities at NAS Jacksonville it might change the NPV associated with both alternatives.

7. Utilization as Metrics are Tracked

If a vehicle-sharing program is adopted at NAS Jacksonville, analysis of utilization data provided by either the government owned or commercial car-sharing telematics units could be conducted. Currently utilization data at NAS Jacksonville for the motor vehicle fleet is not tracked so for the purposes of this CBA it had to be estimated based on actual mileage and a host of assumptions. The utilization data provided by a multi-year pilot at NAS Jacksonville will help future vehicle-sharing pilots and CBAs conducted by the Navy.

8. Increased Use due to Increased Ease of Vehicle Availability

In the fleet-sharing pilot conducted by NAVFAC at Naval Submarine Base (NSB) Bangor, Cook et al. (2013) noted that the implementation of vehicle sharing at this location actually increased the required number of vehicles. Prior to implementation employees were using their personally operated vehicles (POV) for government business because the system in place was overly burdensome. The employees found the vehicle-sharing pilot to be more convenient and utilization increased significantly. If a vehicle-sharing alternative is adopted it will once again be informative to review the data to see the impact of vehicle sharing on utilization.

9. Right Sized Fleet to more Sedans Instead of Trucks

Of the 121 vehicles deemed eligible for vehicle sharing only 10 are sedans. Commands who lease a small number of B-Pool assets have a large ratio of vans and trucks because an individual can use a truck or van to go across base to a meeting but a command cannot use a sedan to get 15 passengers to a gun shoot or pick up bulk supplies

at Servmart. If vehicle sharing were adopted, users will have the ability to choose the appropriate vehicle for each task and activity with the vehicle sharing rates for sedans significantly less than the vehicle sharing rates for large trucks and vans. This could affect the NPV calculations associated with vehicle sharing as utilization data becomes available after implementation.

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